Dana 3-1/2 & 4-1/2 Digit Multimeters

Presenting the most complete line in the world.

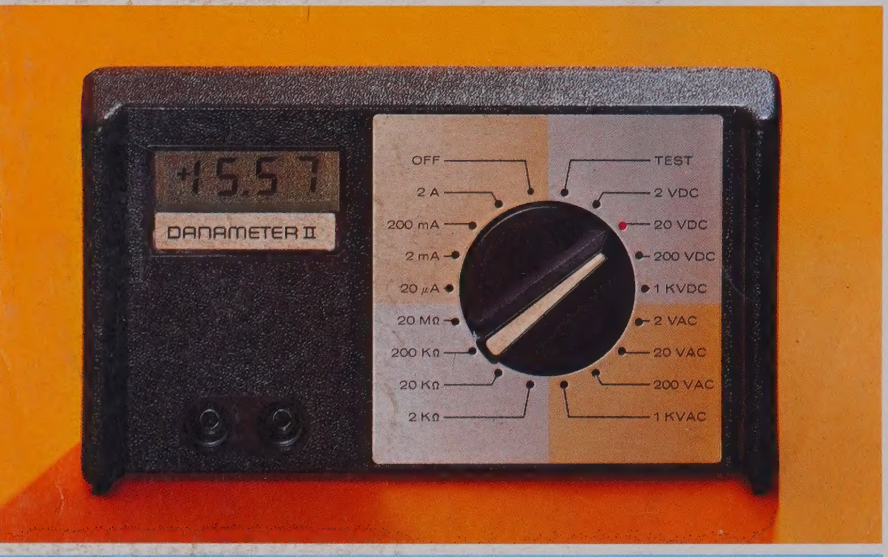
The Dana Line-up

3½ digit dmms

Model 2000A

(See Pages 6 & 7)

- ☐ 0.5% dc accuracy for 3 months or 1 year
- ☐ DCV, ACV, OHMS, DCI*
- ☐ 50dB normal (series) mode noise rejection
- ☐ 1 year battery: no recharging necessary
- ☐ 10MΩ dc input impedance
- ☐ New brighter, faster "Super" LCD



Model 2100A

(See Pages 6 & 7)

- ☐ 0.25% dc accuracy for 1 full year
- ☐ DCV, ACV, OHMS, DCI*
- ☐ 50dB normal (series) mode noise rejection
- ☐ 1 year battery – no recharging necessary
- ☐ 10MΩ dc input impedance
- ☐ New brighter, faster "Super" LCD

Model 3800B

(See Pages 8 & 9)

- ☐ 0.1% dc accuracy for 1 full year
- ☐ DCV, ACV, OHMS, DCI*
- ☐ 50dB normal (series) mode noise rejection
- ☐ AC line (mains) operation
- ☐ 1000MΩ dc input impedance
- ☐ BCD output optional

*ACI optional.

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4½ digit dmms

Model 4200

(See Pages 8 & 9)

- ☐ 0.05% dc accuracy for 1 full year
- ☐ DCV, ACV, OHMS, DCI*
- ☐ 60dB normal (series) mode noise rejection
- ☐ AC line (mains) operation
- ☐ 1000MΩ dc input impedance
- ☐ BCD output optional

Model 4324

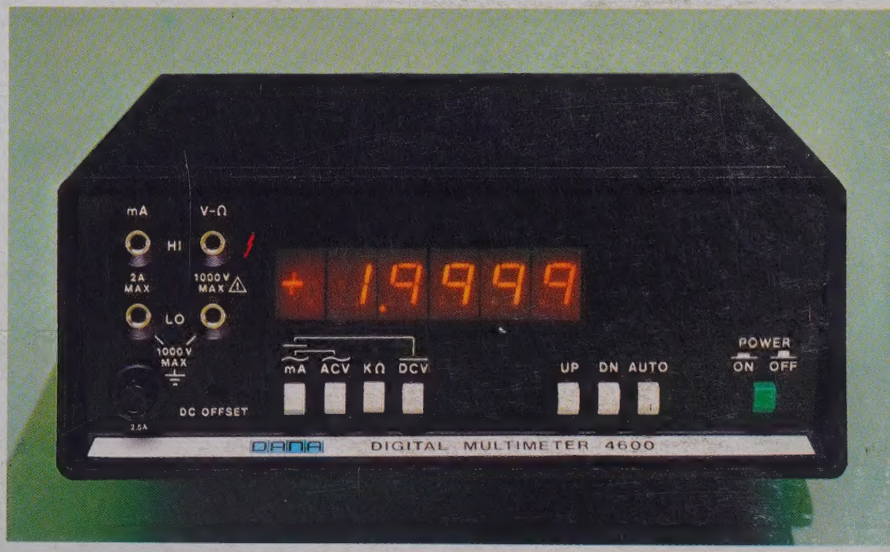
(See Page 10)

- ☐ 0.01% dc accuracy for 6 months
- ☐ DCV, ACV, OHMS
- ☐ 40dB normal (series) mode noise rejection
- ☐ Battery (rechargeable) power or AC line (mains) operation
- ☐ 1000MΩ dc input impedance

Model 4600

(See Pages 4 & 5)

- ☐ 0.01% dc accuracy for 6 months
- ☐ DCV, ACV, OHMS, DCI, ACI
- ☐ 80dB normal (series) mode noise rejection
- ☐ Battery (rechargeable) power or AC line (mains) operation
- ☐ 10,000MΩ dc input impedance
- ☐ BCD output optional



The 4600 Multimeter

The 4600 is a truly unique 4½ digit (20,000 counts) portable multimeter. It combines high accuracy with long term stability, 80dB of normal mode rejection, 10,000 MΩ input impedance, full auto-ranging on each of the five functions, and optional battery operation or BCD output. The 4600's uniqueness is highlighted by the fact that it is a 4½ digit portable instrument, yet it provides accuracies and resolution equal to many 5½ digit DVM's. This makes the 4600 the best value in digital multimeters today.

The instrument is packaged in a small lightweight yet rugged package with a convenient bail/handle. The 4600 may be easily carried and requires a minimum of bench space.

The 4600's versatility is increased by a variety of low cost probes that may be added to the instrument at any time. These include two high voltage probes which safely and accurately measure voltages up to 5000 or 50,000 volts, a linearized RF probe that makes accurate AC voltage measurements up to 200MHz, and a unique hold/print probe which allows the user to hold a reading at the touch of a button or when the unit has been equipped with BCD output, the hold/print probe will command the recording device to print the data when the button is pushed.

0.01% DC Accuracy – Certified for Six Months

The DC accuracy of the 4600 is within 0.01% of the measured reading plus or minus one digit for six full months. This measurement accuracy is fully maintained over the temperature range of 20°C to 30°C and up to 80% relative humidity.

80dB Noise Rejection

The Dana 4600's high accuracy is complemented by 80dB of normal mode rejection. This reduces the effects of noise that cause errors and annoying "run around" by a factor of 10,000 to 1. The 4600's extremely high noise rejection is achieved by combining a filter with an integrator in a unique combination found only in Dana instruments.

The 4600's filter in front of the integrator not only provides 10 times as much noise rejection as most other portable digital voltmeters but also allows the 4600 to accept 10 times more noise amplitude on each range. Digital voltmeters without a filter go into saturation and give erroneous readings whenever the sum of the signal being measured plus noise exceeds the range selected.

10,000 Megohm Input Impedance

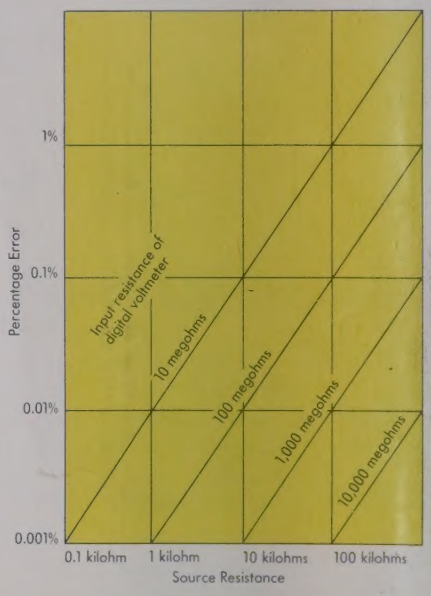
The 4600's potentiometric input provides 10,000MΩ input impedance on the instrument's two lowest ranges. This virtually eliminates the loading errors so often encountered with other digital voltmeters. If a voltage were measured, for example, which has a source resistance of 100KΩ with a conventional 10MΩ input impedance DVM, then the loading error would be 1%. That would be an error of ±100 digits on a 4½ digit instrument and ±1000 digits on a 5½ digit instrument. The 4600 with its 10,000MΩ input impedance would have an error of only 1/10 of one digit and that's like no error at all!

Wide Bandwidth – 100KHz and up to 200 MHz

The linearized RF probe, available for the 4600 (option 84) extends the bandwidth from 100KHz to 200MHz. This lightweight, low cost RF probe is the ideal accessory. It is a unique linearized RF probe because it provides exceptional accuracy not previously available in such probes.

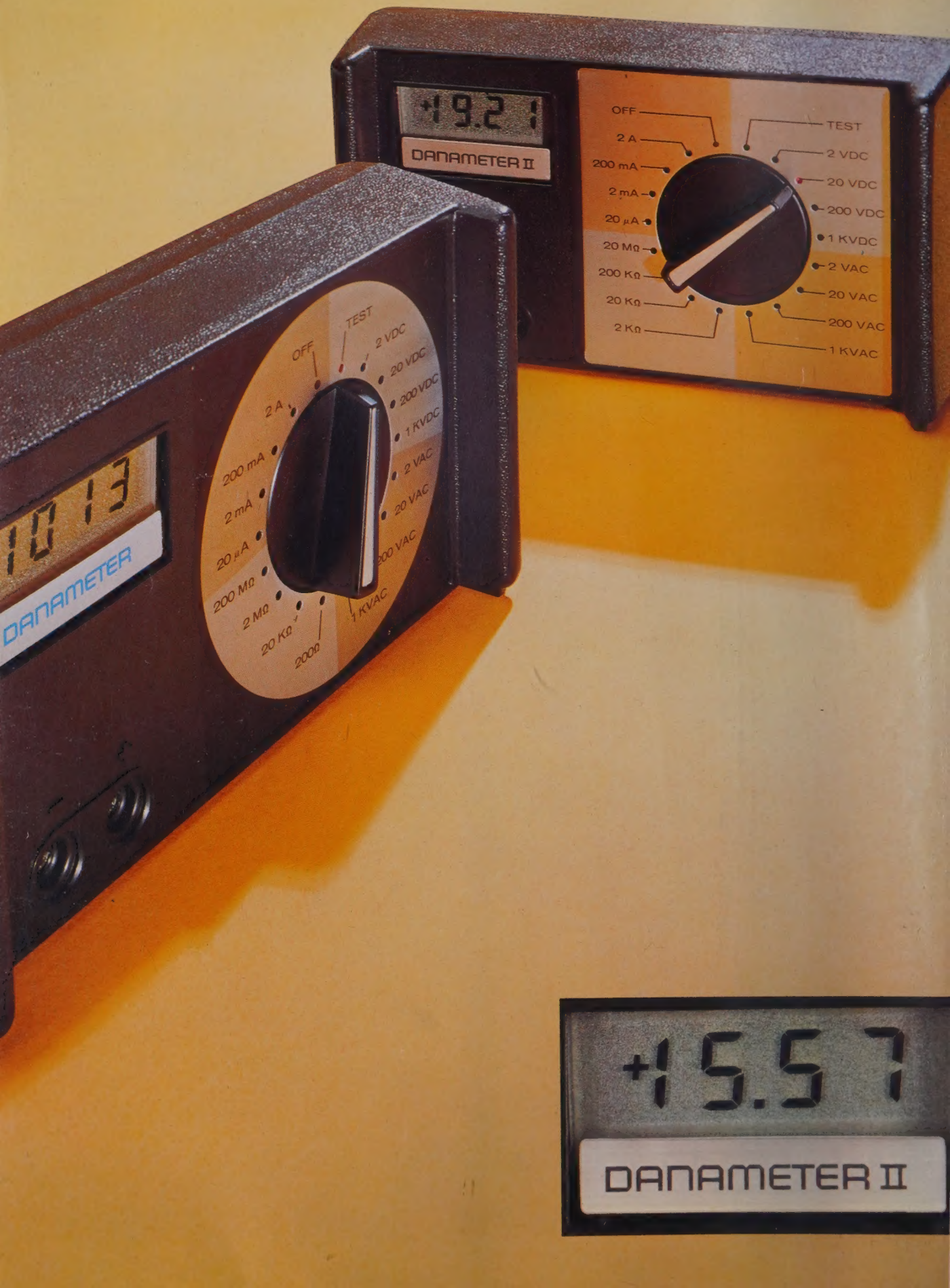
Fully Isolated BCD Output

The Data Output Option 51 provides fully isolated BCD output. The output lines are isolated and buffered through solid state optical couplers permitting interfacing with both grounded and ungrounded printers and/or other equipment while still maintaining the instrument's high common mode noise rejection.



4600 Measurement Capabilities						
DC Volts		0-0.2V 10μV resolution	0-2V .1mV resolution	0-20V 1mV resolution	0-200V 10mV resolution	0-1KV .1V resolution
AC Volts		0-0.2V 10μV resolution	0-2V .1mV resolution	0-20V 1mV resolution	0-200V 10mV resolution	0-1KV .1V resolution
Resistance	0-0.2KΩ 10mΩ resolution	0-2KΩ .1Ω resolution	0-20KΩ 1Ω resolution	0-200KΩ 10Ω resolution	0-2,000KΩ .1KΩ resolution	0-20,000KΩ 1KΩ resolution
DC Current		0-0.2mA 10nA resolution	0-2mA .1μA resolution	0-20mA 1μA resolution	0-200mA 10μA resolution	0-2,000mA .1mA resolution
AC Current		0-0.2mA 10nA resolution	0-2mA .1μA resolution	0-20mA 1μA resolution	0-200mA 10μA resolution	0-2,000mA .1mA resolution

HI
1000 V MAX
LO
1000 V MAX
+ 1.9999
mA
ACV
KΩ
DCV
DC OFFSET
DANA
DIGITAL MULTIMETER 4600
UP
DN
AUTO
POWER
ON
OFF
mA
V-Ω
HI
2A MAX
1000 V MAX
LO
1000 V MAX
DC OFFSET
2.5A


+19.21
DANAMETER II
OFF
2 A
200 mA
2 mA
20 µA
20 MΩ
200 KΩ
20 KΩ
2 KΩ
TEST
2 VDC
20 VDC
200 VDC
1 KVDC
2 VAC
20 VAC
200 VAC
1 KVAC
1013
DANAMETER
+15.57
DANAMETER II

The Danameter® 2000A & Danameter® II 2100A

Versatility

Both Danameters feature DC voltage measurement capability from 1mV to 1000V, AC voltage measurements from 1mV to 1000V peak, DC current measurement capability from 10nA to 2A. The ohms measurement capability of The Danameter is from 0.1Ω to 200MΩ and The Danameter II from 1Ω to 20MΩ. The Danameters can replace several meters at one time and provide capability for your future measurement requirements.

New "Super" Liquid Crystal Display

A new **brighter, faster,** high contrast LCD is now available. This large "super" LCD readout can be easily viewed from any angle, even under the dimmest of lighting conditions or in the brightest sunlight. It is truly brighter and easier to read than LCD's previously in use!

Accuracy

The basic DC accuracy of The Danameter II is within 0.25% of the measured reading plus or minus one digit for one full year. This measurement accuracy is virtually independent of changing temperature and humidity which influence other instruments. It is the most accurate/**truly portable** instrument in the world.

Reliability

The Danameter and Danameter II represent a significant breakthrough in the state-of-the-art. As a result of large-scale integration, there are at least 50% fewer components in a Danameter than in other 3½ digit instruments. The all solid-state circuitry runs cooler, lasts longer and is more rugged. There is less to go wrong, less to trouble-shoot, and less for you to worry about.

The Danameters display the battery condition in a test position, so there's no danger of being caught with a dead battery.

Economical

The Danameters are excellent investments as their low purchase price is enhanced by nominal maintenance cost. In the unlikely event of a repair, it can be made quickly and inexpensively. All components are readily accessible and easily changed.

One-Year Battery Life

The 9V transistor radio battery that powers The Danameter and The Danameter II will last one full year. This means you will never have to bother with line cords, or fool with recharging or constant battery replacement. When the battery finally does wear out, you'll find a replacement at the corner store.

Easy to Use

You will find that Danameters are as convenient as a flashlight. Small in size and light in weight, they are easy to carry into the field or around the lab. You will appreciate the simple single control switch, autopolarity, automatic decimal point and the handy bail/foot feature that allows one-handed use.

One-Year Calibration

Because of its high stability reference, The Danameter II can stay out in the field for a full year without losing its accuracy. This feature will save you downtime, money and hassle. The Danameter's Option 03 incorporates this same stable reference, extending its accuracy specifications from 90 days to one year.

Nearly Indestructible

The Danameters are encased in cycolac™. They won't rust, chip or peel. They are shockproof, stainproof, coldproof and easy to clean. The molded shoulders protect the readout window and the switch. These instruments are designed to withstand heavy field abuse. You can drop them on concrete. When you pick them up, they will be working perfectly.

Safety Approved

All Danameters bear the MESA approval label certifying that they have been tested and approved for use in explosive atmospheres. They are certified safe for use in mines, refineries, processing plants and other explosive environments.

DANA LABORATORIES INCORPORATED
DANAMETERS

APPROVAL 2G-2884

United States Department of the Interior
mesa
Mining Enforcement and Safety Administration

MODELS 2000 & 2100

Tested in methane-air mixtures
for electrical safety only.

The 3800B & 4200 Multimeters

The Dana Models 3800B and 4200 Digital Multimeters include a number of premium features that increase performance, in addition to providing full multifunction capability. These instruments have a 3-pole active filter in addition to an integrator. This means freedom from errors caused by all types of noise – not just power-line hum! These instruments also feature 1000MΩ input impedance to reduce the loading errors so common with inexpensive digital voltmeters.

The 3800B is a 3½ digit (2000 counts) DVM featuring DC measurements from 100μV to 1000V, AC measurements from 1mV to 500V RMS, ohms measurements from 100mΩ to 20MΩ and current measurements from 10nA to 2A. In addition, a fully isolated data output option provides up to 60 readings/second.

The 4200 is a 4½ digit (20,000 counts) DVM featuring DC measurements from 10μV to 500V RMS, ohms measurements from 10mΩ to 20MΩ and current measurements from 1nA to 2A. In addition, a fully isolated data output option is available which provides up to 6 readings/second.

100KHz Bandwidth

The wideband, average responding, AC converter (calibrated in RMS) covers a bandwidth of 40Hz to 100KHz. This bandwidth provides both added capabilities as well as improvements in accuracy. Four AC ranges (2, 20, 200, 2000V RMS) provide resolution of 100μV in the 4200 and 1mV in the 3800B over the entire bandwidth.

Fast Response

The 3800B and 4200 make 6 measurements per second. This fast response capability eliminates "waiting" to get a reading. It also allows tracking of rapidly changing signals. The full-scale step response of the instruments is less than 1 second for most measurements, depending on the function and range of operation.

1 Nanoamp Current Resolution

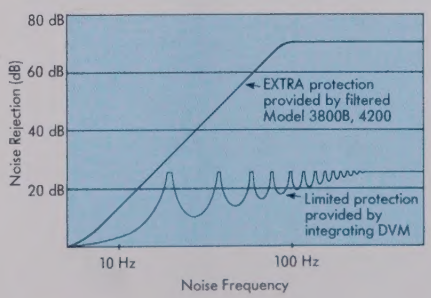
The 4200 is capable of resolving and tracking signals with a resolution of 1nA. The 3800B has a resolution of 10nA. Both instruments provide a 20μ Amp range – this important feature is often left out of other instruments.

Fully Isolated BCD Output

The Data Output Option 51 provides fully isolated BCD output. The output lines are isolated and buffered through solid state optical couplers, permitting interfacing with both grounded and ungrounded printers and/or other equipment, while still maintaining the instrument's high common mode noise rejection. In addition, the 3800B provides output data at a rate of up to 60 readings/second. The 4200 provides 6 readings/second.

0.05% DC Accuracy – One Year

The DC Accuracy of the 4200 is within 0.05% of the measured reading plus or minus four digits for one full year. The Model 3800B has an accuracy of 0.1% of reading and plus or minus one digit, also for one year. This measurement accuracy is fully maintained over the temperature range of 15°C to 35°C and up to 80% relative humidity.



1000 Megohms Input Resistance

The DC accuracy is assured by the high input resistance. The 1000MΩ input resistance on the 2V range, for example, permits measurement of a 1MΩ source with less than 0.1% loading error. This eliminates annoying changes in the measured readings due to source resistance changes. In addition, the automatic zero circuitry has been designed to eliminate "kick-back" current, which can often interfere with the operation of the device under test – a common problem found with many automatic zeroing instruments.

One-Year Stability

A highly stable zener diode internal voltage reference guarantees the stability of the 3800B and 4200 to be within their rated accuracies for a minimum period of one year, eliminating the need for frequent calibration. The zener reference circuitry in these instruments is comparable to the circuitry found in our more expensive multimeters.

Outstanding Noise Rejection

A quick-response, 3-pole active filter is built into the input circuitry of this series of digital multimeters. This filter, combined with dual slope integration, provides a normal mode rejection of greater than 60dB over a bandwidth to 1MHz, not just at power line frequency. This represents a 1000-to-1 reduction of superimposed noise. In addition, common mode signals, such as ground loops and noisy environments, are virtually eliminated by the rejection ratio of 100dB (100,000-to-1).

DANA
+1950
VDC
VAC
mA
μA
KΩ
20
200
2
2000
200mVDC
200Ω
20MΩ
VDC
VAC
mADC
μADC
Ω
DANA DIGITAL MULTIMETER 4200
POWER
ON
OFF
OFFSET
VOLTS
COMMON
Ω/AMPS
1KVDC
500VAC
MAX
2V MAX
500V
MAX
+1963
200mVDC
200Ω
DANA DIGITAL MULTIMETER 3800B
POWER
ON
OFF
OFFSET

The 4324 Militarized Multimeter

Wide Capability

The Model 4324 is a 4½ digit (20,000 counts) multimeter which provides wide operational capability and versatility. Five ranges of DC, including a 100mV range, four ranges of AC, and five ohm ranges, are standard. In addition, special input circuitry offers an input resistance of 1000MΩ. This assures accuracy when measuring high impedance sources.

Accuracy

DC accuracy is within 0.01% of the measured reading plus or minus one digit for 6 months. Additional accuracy specifications, for all modes of operation, are stated for 12 months. Long-term accuracy specifications permit the lengthening of calibration cycles and significantly reduce calibration costs.

Battery Operation

A self-contained battery option provides eight hours of continuous operation. These nickel cadmium batteries are rechargeable while operating from the power line (mains) and can be installed easily, even in the field. The 4324's battery charging technique is unique, in that it features a switch position for digital readout of battery voltage, a chart to determine the approximate unused battery time, an automatic shut-off when the battery voltage reaches the recharge level, and a battery interrupt that automatically turns off the instrument when the transit cover is in place over the front panel.

Militarized Specifications

This instrument has been designed and tested to meet all environmental requirements of MIL-T-21200K, Class II. In addition, it meets the requirements of MIL-T-28800, Type I, Class 2, Style A. It is ideal for bench, field, and flight line applications. In addition, two National Stock Numbers have been assigned: 6625-00-551-8009 and 4935-01-004-2937.

Fully Portable

The 4324 is housed in a rugged, compact and portable aluminum case. A handle on the transit cover makes it easy to carry. The transit cover is also side-hinged for easy removal and has a compartment to store cables and various instrument accessories.

Specifications

Model	2000A	2100A	3800B	4200	4324	4600
Digits	3-1/2	3-1/2	3-1/2	4-1/2	4-1/2	4-1/2
Overrange	100%	100%	100%	100%	100%	100%
Display	1999	1999	1999	19999	19999	19999
Type	LCD	LCD	LED	LED	LED	LED
Range Selection	Manual	Manual	Manual	Manual	Manual	Automatic All Functions
DC VOLTAGE						
Ranges	±2, ±20, ±200 ±1000	±2, ±20, ±200 ±1000	±200m, ±2, ±20 ±200, ±1000	±200m, ±2, ±20 ±200, ±1000	±200m, ±2, ±20 ±200, ±1000	±0.2, ±2, ±20 ±200, ±1000
Polarity	Automatic & Bipolar	Automatic & Bipolar	Automatic & Bipolar	Automatic & Bipolar	Automatic & Bipolar	Automatic & Bipolar
Maximum Resolution	1 mV	1 mV	100 μV	10 μV	10 μV	10 μV
Accuracy	0.5% Reading + 1 Digit except 20, 200 & 1 KV Ranges Add: 0.25% Reading	0.25% Reading + 1 Digit except 20, 200 & 1 KV Ranges Add: 0.10% Reading	0.1% Reading + 1 Digit	0.05% Reading + 4 Digits	0.01% Reading + 2 Digits except 0.2V Range 0.03% Reading + 4 Digits	0.01% Reading + 1 Digit except 0.2V Range 0.02% Reading + 2 Digits
Conditions	3 Months, 20°C–30°C	One Year, 20°C–30°C	One Year, 15°C–35°C	One Year, 15°C–35°C	6 Months, 15°C–35°C	6 Months 20°C–30°C
Input Resistance	10 MΩ	10 MΩ	1000 MΩ 200 mV, 2V Ranges 10 MΩ 20–1 KV Ranges	1000 MΩ 200 mV, 2V Ranges 10 MΩ 20–1 KV Ranges	1000 MΩ 200 mV, 2V Ranges 10 MΩ 20–1 KV Ranges	10,000 MΩ 0.2 & 2V Ranges 10 MΩ 20–1 KV Ranges
Normal Mode Noise Rejection @ 50 & 60 Hz	50 dB	50 dB	60 dB	60 dB	40 dB	80 dB
Common Mode Noise Rejection (1 KΩ Imbalance in either lead)	120 dB at 50 & 60 Hz	120 dB at 50 & 60 Hz	100 dB at 50 & 60 Hz	100 dB at 50 & 60 Hz	120 dB at 50 & 60 Hz	140 dB at DC 120 dB at 50 & 60 Hz
Response Time To Rated Accuracy	1 Second	1 Second	1 Second	1 Second	<1 Second	700 mSec, 2-1/2 Sec for 1 KV Step Input
Overload Protection Any Range	1000 VDC or peak AC	1000 VDC or peak AC	1000 VDC or peak AC	1000 VDC or peak AC	1000 VDC or peak AC	1000 VDC or RMS
AC VOLTAGE						
Ranges	2, 20, 200, 1000	2, 20, 200, 1000	2, 20, 200, 500	2, 20, 200, 500	2, 20, 200, 1000	0.2, 2, 20, 200, 1000
Maximum Resolution	1 mV	1 mV	1 mV	100 μV	100 μV	10 μV
Accuracy	45 Hz to 400 Hz 1.00% Reading + 3 Digits 400 Hz to 4 kHz* 2.5% Reading + 3 Digits *2 kHz on 2V Range	45 Hz to 400 Hz 0.50% Reading + 2 Digits 400 Hz to 4 kHz* 1.5% Reading + 2 Digits *2 kHz on 2V Range	40 Hz to 1 kHz 0.30% Reading + 1 Digit 1 kHz to 10 kHz 0.40% Reading + 1 Digit 10 kHz to 20 kHz 0.60% Reading + 1 Digit 20 kHz to 100 kHz 0.90% Reading + 1 Digit	40 Hz to 100 Hz 1 kHz to 10 kHz 0.30% Reading + 10 Digits 100 Hz to 1 kHz 0.20% Reading + 10 Digits 10 kHz to 20 kHz 0.60% Reading + 10 Digits 20 kHz to 100 kHz 0.8% Reading + 10 Digits	50 Hz to 10 kHz 0.20% Reading + 8 Digits 10 kHz to 20 kHz 0.50% Reading + 10 Digits	30 Hz to 50 Hz 0.25% Reading +30* Digits (*70 Digits on 0.2V Range) 50 Hz to 20 kHz 0.09% Reading +10* Digits (*30 Digits on 0.2V Range) 20 kHz to 50 kHz 0.10% Reading +16* Digits 50 kHz to 100 kHz 0.07% Reading +16 Digits (*40 Digits on 0.2V Range)

Model	2000A	2100A	3800B	4200	4324	4600
AC VOLTAGE (continued)						
Conditions	3 Months, 20°C–30°C	One Year, 20°C–30°C	One Year, 15°C–35°C	One Year, 15°C–35°C	6 Months, 15°C–35°C	6 Months, 15°C–35°C
Input Impedance	2 MΩ/50 pF	2 MΩ/50 pF	1 MΩ/100 pF	1 MΩ/100 pF	1 MΩ/200 pF	1 MΩ/100 pF
Response Time To Rated Accuracy	Less Than 2 Seconds	Less Than 2 Seconds	Less Than 2 Seconds	Less Than 2 Seconds	3 Seconds	Less Than 2 Seconds
Overload Protection Any Range	1000V peak AC or 250V DC	1000V peak AC or 250V DC	500V RMS to 10 kHz	500V RMS to 10 kHz	1000V RMS or 500V DC	1000V RMS ≤$2x10^7$ VHz
RESISTANCE						
Ranges	200, 20K, 2M, 200M	2K, 20K, 200K, 20M	200, 2K, 20K, 200K, 2M, 20M	200, 2K, 20K, 200K, 2M, 20M	2K, 20K, 200K, 2M, 20M	200, 2K, 20K, 200K, 2M, 20M
Maximum Resolution	100 mΩ	1Ω	100 mΩ	10 mΩ	100 mΩ	10 mΩ
Accuracy:						
200Ω Range	3% Reading + 3 Digits		0.4% Reading + 2 Digits	0.1% Reading + 8 Digits		0.05% Reading + 2 Digits
2K, 20K, 200K Ohm Ranges	1% Reading + 2 Digits	0.5% Reading + 2 Digits	0.2% Reading + 1 Digit	0.05% Reading + 4 Digits	0.02% Reading + 2 Digits	0.05% Reading + 1 Digit
2 MΩ Range	3% Reading + 1 Digit		0.4% Reading + 2 Digits	0.1% Reading + 8 Digits	0.07% Reading + 2 Digits	0.10% Reading + 1 Digit
20 MΩ Range		0.75% Reading + 1 Digit	1.0% Reading + 1 Digit	0.5% Reading + 8 Digits	0.07% Reading + 2 Digits	0.20% Reading + 1 Digit
200 MΩ Range	7.5% Reading + 1 Digit					
Conditions	3 Months, 20°C–30°C	One Year, 20°C–30°C	One Year, 15°C–35°C	One Year, 15°C–35°C	6 Months, 15°C–35°C	6 Months, 20°C–30°C
Maximum Open Circuit Voltage	4V	4V	15V except 5V on 20 MΩ Range	15V except 5V on 20 MΩ Range	8V	7V
Response Time To Rated Accuracy						
Range						
200–200K	Less Than 2 Seconds All Ranges	Less Than 2 Seconds All Ranges	Less Than 2 Seconds	Less Than 2 Seconds	1 Second	Less Than 1 Second All Ranges
2M			2 Seconds	2 Seconds	5 Seconds	
20M			12 Seconds	12 Seconds	10 Seconds	
Overload Protection Any Range	250V DC or 250V RMS	250V DC or 250V RMS	250V DC or 250V RMS	250V DC or 250V RMS	250V DC or 250V RMS	250V DC or 250V peak AC
DC CURRENT						
Ranges	±20μ, ±2m, ±200m, ±2	±2μ, ±2m, ±200m, ±2	±20μ, ±200μ, ±2m, ±20m, ±200m, ±2000m	±20μ, ±200μ, ±2m, ±20m, ±200m, ±2000m		±0.2m, ±2m, ±20m, ±200m, ±2000m
Maximum Resolution	10 nA	10 nA	10 nA	1 nA		10 nA
Accuracy						
All Ranges except 2A Range	2.0% Reading + 2 Digits	0.5% Reading + 2 Digits	0.2% Reading + 1 Digit	0.2% Reading + 4 Digits		0.12% Reading + 4 Digits
	2.0% Reading + 2 Digits	0.5% Reading + 2 Digits	0.4% Reading + 1 Digit	0.3% Reading + 4 Digits		0.3% Reading + 20 Digits
Conditions	3 Months, 20°C–30°C	One Year, 20°C–30°C	One Year, 15°C–35°C	One Year, 15°C–35°C		6 Months, 20°C–30°C
Voltage Burden	Maximum 0.25V	Maximum 0.25V	20μ, 2m, 200m Ranges: 0.2V 200μ, 20m, 2A Ranges: 2V	20μ, 2m, 200m, Ranges: 0.2V 200μ, 20m, 2A Ranges: 2V		All Ranges 0.2V except 2A 0.5V
Overload Protection Any Range	250V DC or 250V RMS	250V DC or 250V RMS	250V DC or 250V RMS	250V DC or 250V RMS		250V DC or 250V RMS
Fuse Protection Any Range	2 Amps	2 Amps	2 Amps	2 Amps		2.5 Amps

Model	2000A	2100A	3800B	4200	4324	4600
AC CURRENT						
Option Number (See pg. 15)	Option 86 for Model 2000	Option 86 for Model 2100	Option 86 for Model 3800B	Option 86 for Model 4200		Standard
Ranges	2m, 2	2m, 2	200μ, 2m, 20m, 200m, 2A	200μ, 2m, 20m, 200m, 2A		0.2m, 2m, 20m, 200m, 2000m
Maximum Resolution	1 μA	1 μA	100 nA	10 nA		10 nA
Accuracy All Ranges except 2A Range	45–400 Hz 1.0% Reading + 3 Digits	45–400 Hz 0.5% Reading + 2 Digits	50–10 kHz 0.5% Reading + 1 Digit 0.7% Reading + 1 Digit	50–10 kHz 0.5% Reading + 10 Digits 0.7% Reading + 10 Digits		50–10 kHz 0.2% Reading + 20 Digits 0.30% Reading +20 Digits
Conditions	3 Months, 20°C–30°C	One Year, 20°C–30°C	One Year, 15°C–35°C	One Year, 15°C–35°C		6 Months, 20°C–30°C
Voltage Burden	2V	2V	2V	2V		0.2V except on 2A Range: 0.5V
Overload Protection Any Range	20 mA or 2A	20 mA or 2A	200% of Range to 2A max.	200% of Range to 2A max.		2.5A
Fuse Protection Any Range	Shunt	Shunt	Shunt	Shunt		2.5A
DATA OUTPUT (See descriptions on pg. 15)						
Option Number			Option 51 for Model 3800B	Option 51 for Model 4200		Option 51 for Model 4600
Outputs True False			TTL Compatible 1-2-4-8 BCD +2.4V minimum +.8V maximum	TTL Compatible 1-2-4-8 BCD +2.4V minimum +.8V maximum		TTL Compatible 1-2-4-8 BCD +2.4V minimum +.8V maximum
Input Commands			Hold and Read	Hold and Read		Hold/Read and Serial Data Strobe
Power Requirements			Regulated 5V @ 200 mA to power TTL logic	Regulated 5V @ 200 mA to power TTL logic		No External Power required
Maximum Readings/Sec			60	6		2-1/2
GENERAL						
Digitizing Time	300 mSec	300 mSec	8 mSec	8 mSec	150 mSec	300 mSec
Read Rate	2.5 per Sec	2.5 per Sec	6 or 60 per Sec	6 per Sec	5 per Sec	2.5 per Sec
Maximum Common Mode Voltage	1000 VDC or 1000V peak AC	1000 VDC or 1000V peak AC	500 VDC or 500V RMS	500 VDC or 500V RMS	1000 VDC or 1000V peak AC	1000 VDC or 1000V peak AC
Overrange Indication	OL	OL	Flashing Display	Flashing Display	Flashing Display	Flashing Display
Power Requirement	One 9V Dry Cell Battery, NEDA #1604, estimated battery life one year	One 9V Dry Cell Battery, NEDA #1604, estimated battery life one year	10 Watts @ 50–70 Hz & 115V ±10% or 230V ±10%	10 Watts @ 50–70 Hz & 115V ±10% or 230V ±10%	6 Watts @ 50–400 Hz & 105, 125, 210 or 230V ± 10% Also battery pack – Option 06	10 Watts @ 50–400 Hz & 100, 120, 220 or 240V ± 10% Also battery pack – Option 70
Operating Temperature	5°C to 50°C	0°C to 50°C	0°C to 50°C	0°C to 50°C	–40°C to +55°C	0°C to 50°C
Storage Temperature	–40°C to +60°C	–40°C to +60°C	–20°C to +65°C	–20°C to +65°C	–62°C to +85°C	–20°C to +75°C
Warm-Up Time	2 Seconds to Full Accuracy	2 Seconds to Full Accuracy	30 Minutes to Full Accuracy	30 Minutes to Full Accuracy	30 Minutes to Full Accuracy	30 Minutes to Full Accuracy
Dimensions cm Inches	10.2x18.4x5.7 4x7-1/4x2-1/4	10.2x18.4x5.7 4x7-1/4x2-1/4	8.9x21.6x28.6 3-1/2x8-1/2x11-1/4	8.9x21.6x28.6 3-1/2x8-1/2x11-1/4	16.0x28.6x43.2 6-1/4x11-1/4x17	7.3x20.0x25.0 2.9x7.9x9.8
Weight Net Shipping	0.5 kg/1 lb. With Battery	0.5 kg/1 lb. With Battery	2.7 kg/6 lbs. 3.6 kg/8 lbs.	2.7 kg/6 lbs. 3.6 kg/8 lbs.	10 kg/22 lbs. 11 kg/24 lbs.	2.3 kg/5 lbs. 3.2 kg/7 lbs.
Guarantee	12 Full Months – repair or replace malfunctions due to faulty workmanship or component failure					

Other Products in the Complete Dana Line

4800

A premium 4½ digit instrument with DCV, ACV, ohms and ratio functions combining the high accuracy and versatility required in laboratory applications with the speed, BCD output, and remote programming capability required in systems applications.

5000*

The 5000 is a low-cost 5½ digit multimeter designed to offer features found in higher priced products. Some of the features are True RMS AC, four wire/four quadrant autopolarity DC/DC ratio, a switchable filter, and interface capability.

5800A

A premium performance five digit instrument providing full ratio capability, DCV, ACV and ohms. The 5800A will accept either an external DC or AC reference voltage for making real time ratio measurements. Nine ohm ranges, 1 ohm to 100 megohms full scale, are available to provide resolutions down to 10 μohms.

5900*

A 5½ digit multimeter, the 5900 provides the ultimate in accuracy and stability. Its 90 day accuracy of ±.001% R ±1 digit on the 10V range is better than any other 5½ digit instrument's 24 hour accuracy. In addition, the 5900 offers True RMS AC, eight ohms ranges, ratio, and full systems capability.

6900*

The Dana Series 6900 Precision Voltmeter is a unique 6½ digit (1,600,000 counts) instrument, combining the stability of a transfer standard with the speed, ease of use, and multifunction capability of a digital multimeter.

7500

Two models make up the Dana Series 7500 counters providing frequency measurement capability up to 1GHz with 10mV RMS sensitivity. Both models provide high impedance direct count capability to 200MHz with input sensitivity adjustment from 50mV RMS to 250V RMS.

8000B

The Dana Series 8000B counters provide full universal counter/timer capabilities. Each model has been designed and developed to provide measurement capability for any application that requires an economical, reliable, and versatile electronic counter. Each model is self-contained, eliminating the need for multiple plug-ins.

9000*

Dana Series 9000 is the world's most advanced line of electronic timer/counters. Microprocessing control provides all the features of a premium timer/counter, a reciprocating counter, and a calculator, plus operating capabilities and interface options never before available in one instrument.

*GPIB (IEEE Std 488-1975) systems interface now available.

For complete data sheets and more information contact Dana Laboratories or your Dana representative.

Accessories

0 – Rack Mounting Flanges for 2000A/2100A/ 3800B/4200/4600 (not shown)
ermits the unit to be left- or right-hand mounted in a andard 19 inch, 3½ inch high instrument rack.

1 – Carrying Case for 2000A/2100A
ne Danameter carrying case, Model 61, will hold the eter, manual and test leads.

2 – Double Rack Mounting Adaptor for 2000A and 2100A (not shown)
ermits 2 Danameters to be mounted in a standard inch, 3½ inch high instrument rack.

0 – Input Cable for all instruments (not shown)
his is a 5 foot long shielded cable with hooded alligator ip probes and dual banana plug for mating the cable the instrument. Especially useful in high noise vironments.

0 – Test lead set for the 4324 (not shown)
vo 4 foot long leads with assorted tips all included a carrying case.

1 – Hold Probe for the 4600
button on the probe allows the operator to push to hold push to read a measurement. The probe can handle to 500V DC or AC RMS.

2 – High Voltage Probe, 5KV, for all instruments
xtends the DC measurement capability of the instrument 5000 volts.

ccuracy . . . . . (0-5KV, 0 to +50°C) ±2% of input with 10Mohms DMM load
aximum Input . . . . . 5KV DC
put Resistance . . . . . 900Mohms nominal
vision Ratio 1000:1

3 – High Voltage Probe, 50KV, for all instruments
xtends the DC measurement capability of the instrument 50,000 volts.

ccuracy . . . . . (0-45KV, 0 to +50°C) ±5% of input with 10Mohm DMM load
aximum Input . . . . . 50KV DC
put Resistance . . . . . 900Mohms nominal
vision Ratio 1000:1

84 – R.F. Probe, 200MHz, for all instruments
Extends the capabilities of the instrument to the measurement of RF frequency, from 1kHz to 200MHz at RMS voltage levels up to 30 volts. The probe converts the RF signal to the DC equivalent voltage.

Accuracy . . . . . ±5°C, 6 mos., 0-25V RMS
1KHz to 10MHz . . . . . ±(1% input +50mV)
10MHz to 100MHz . . . ±(1dB input +50mV)
100MHz to 200MHz . . ±(3dB input +50mV)
Input Impedance 1.6Mohm, 7pF
Maximum Input . . . . . 125V rms AC, 60-400Hz, 250VDC

86 – AC Current Shunts for the 2000A/2100A
Extends the Danameters' measurement capabilities to include AC current measurement. The accessory consists of two precision shunt resistors molded in color-coded, dual banana plug/sockets. The desired shunt is connected between the instrument and the input cable. See "Specifications."

86 – AC Current Shunts for the 3800B/4200
Five precision shunt resistors molded in color coded dual banana plug/sockets extend the 3800B or 4200's measurement capability to include AC current measurement. See "Specifications."

87 – Input Cable for the 4324 (not shown)
Consists of 6.5 feet of unshielded cable with two probes for measurement and a molded dual banana plug/socket for connection to the 4324.

88 – Deluxe Test Lead Set for all instruments
Designed to withstand the everyday, continuous on-the-line use in production testing or field use. The probes come equipped with assorted tips and carrying case.

89 – Standard Test Lead Set for all instruments (not shown)
Standard test leads with 90 degree banana plugs and replaceable "phonograph needle" tips.

Options

06 – Battery Pack for the 4324 (not shown)
With the battery pack, the 4324 operates on power line voltage or on self-contained batteries. The batteries provide 8 hours of continuous operation and charge fully in 16 hours of line voltage operation.

51 – BCD Output for the 3800B/4200 (not shown) See page 8.
The isolated BCD output provides numeric and polarity information to printers or other digitally operated equipment. The output of the option is completely isolated, preserving the instrument's common mode noise rejection characteristics, even when connected to grounded equipment. The output connector provided is a CINCH 251 18 30 160 50 36A 30 (Dana P/N 600227).

51 – BCD Output for the 4600 (not shown) See page 4.
The isolated BCD output provides numeric, range, function, and polarity information to printers or other digitally operated equipment. The output is available in either a parallel or serial format. The output connector provided is a CINCH 251 18 30 160 50 36A 30 (Dana P/N 600227).

70 – Battery Pack for the 4600 (not shown)
With the battery pack, the 4600 operates on power line voltage or on self-contained batteries. The batteries typically provide 8 hours of operation and charge fully in 16 hours of line voltage operation.

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DANA®

Dana Laboratories, Inc., 2401 Campus Drive, Irvine, California 92715, U.S.A.
Telephone: (714) 833-1234, Teletype: 910-595-1136, Telex: 67-8341

All DMM's are available on GSA Contract No. GS-00S-27543

Series 6900
Precision Voltmeter

DANA®

Others measure by us.

The 6900 as a Voltmeter.

The Dana Series 6900 Precision Voltmeter is a unique 6½-digit (1,600,000 counts) instrument, combining the stability of a transfer standard with the speed, ease of use, and multifunction capability of a digital voltmeter.

This level of performance has never before been available at the price of the Model 6900.

24 Hour Relative Accuracy.

A precision voltmeter's 24-hour relative accuracy specification is a meaningful measure of its inherent stability and linearity. It gives a true indication of the accuracy designed and built into the instrument. The excellent relative accuracy of the 6900 recommends its use as a working transfer standard between in-house standards and the manufacturing floor or lab.

The 6900 relative accuracy specification then is its transfer accuracy and defines the working standard accuracy available at the time of calibration relative to the in-house standard.

RANGE	RELATIVE ACCURACY* 24 Hours, 23°C±1°C, <70% relative humidity
.1V	±(20 ppm of reading + 50 ppm of full scale)
1V	±(6 ppm of reading + 5 ppm of full scale)
10V	±(3 ppm of reading + 3 ppm of full scale)
100V	±(5 ppm of reading + 5 ppm of full scale)
1000V	±(5 ppm of reading + 5 ppm of full scale)

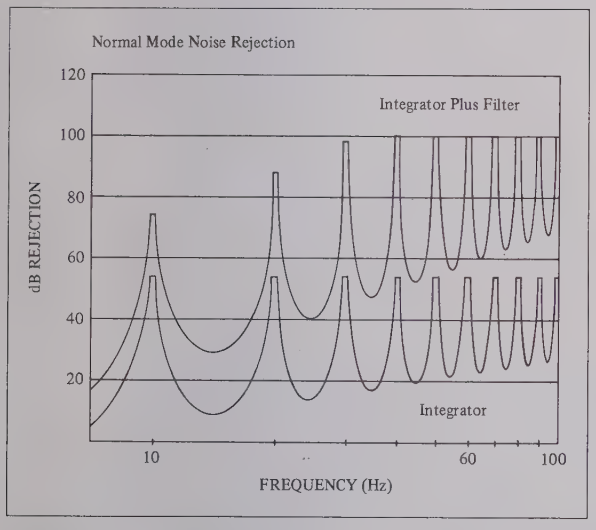
Relative accuracy includes all inherent nonlinearities.

1 ppm Sensitivity. Sensitivity is the smallest unit of the measured value that can be effectively detected and displayed. It is an important aspect of the precision of an instrument in that it determines the minimum uncertainty that an instrument possesses; i.e., an instrument's uncertainty can be no smaller than the smallest increment that can be effectively detected and displayed. The 6900's 6½ digit readout permits 1 ppm resolution on each of the 5 DC voltage ranges. Voltage changes as small as ± 1 ppm (±1 digit) can be effectively detected on the 1V-1000V ranges; and, as small as ± 3 ppm (±3 digits) can be effectively detected on the .1V range.

NMR/ECMR. It must be recognized that a precision instrument may operate in a hostile electrical environment and that the instrument's noise rejecting capabilities, both normal mode and common mode, are prime indicators of the precision that it may achieve.

The 6900's 100 dB normal mode rejection at line frequency translates to 100,000 to 1 reduction of any line frequency noise that is superimposed on the DC value being measured. Thus, 10 millivolts of noise on the 1V range would not appear on the display, since it has been reduced to 100 nanovolts, one decade below the 1 microvolt sensitivity of the 6900.

Effective Common Mode Noise Rejection is the ratio of the common mode noise to its resulting effect on the displayed value. For the 6900, a reduction of 10,000,000 to one (140 dB) is achieved for all common mode noise between DC and 61Hz.



Input Impedance. While not directly affecting the precision of the voltmeter, its input impedance does provide an indication of how little the voltmeter interacts with the source being measured. What "loading errors" are contributed by the voltmeter when attached to the source being measured is determined by the instrument's input impedance relative to the impedance of the source.

The 6900 provides greater than 100,000 megohms input impedance on the .1, 1 and 10 Volt ranges. This means, for example, that outputs from low-level sensors with impedances as high as 100 kilohms can be measured with less than 1 ppm loading errors. In addition, the 6900 does not exhibit the "off-null loading errors" that are encountered in potentiometric balancing devices now commonly used.

The 6900 as a DC Transfer Standard.

Because of the 6900's high resolution (0.625 ppm) and extremely desirable short-term stability, the 6900 becomes an extremely versatile working transfer standard.

Just measure your standard with the 6900 and record the reading. Then take the 6900 to the source to be calibrated. Connect the voltmeter to the source to be calibrated and adjust the source until the voltmeter displays the same reading as recorded for the standard. Your source is now calibrated to your standard within the short-term stability of the 6900.

Dana Laboratories' Calibration Standard. This is the accuracy of the equipment at Dana Laboratories by which the 6900 is calibrated. Thus, if a more accurate calibration standard is available, the resulting absolute accuracy of the 6900 can more closely approach its inherent stability.

RANGE	DANA LABORATORIES' CALIBRATION STANDARD ACCURACIES
.1V	± 17 ppm
1V	± 2 ppm
10V	± 2 ppm
100V	± 4 ppm
1000V	± 10 ppm

The 6900 as a Multimeter.

A voltmeter must provide not only precise measurements, but also accurate measurements, if the instrument is to be of use for an extended period of time over an extended operating environment. The 6900 is designed to provide more than just laboratory environment capabilities. With its resistance and AC voltage measurement capabilities, the 6900 becomes an ideal secondary standard for calibration of production floor standards and sources as well as R & D laboratory equipment.

DC Volts.

The absolute accuracy of the 6900 is the summation of its relative accuracy specification and the accurate standard to which it is calibrated. Thus, the 6900 absolute accuracy specification can be made to approach its relative accuracy specification through the use of a more accurate calibration standard. The accuracy to which Dana Laboratories will provide the 6900 is:

RANGE	24 HOUR ACCURACY 23°C, ±1°C, <70% relative humidity
.1V	±(37 ppm of reading + 50 ppm of full scale)
1V	±(10 ppm of reading + 5 ppm of full scale)
10V	±(5 ppm of reading + 3 ppm of full scale)
100V	±(9 ppm of reading + 5 ppm of full scale)
1000V	±(15 ppm of reading + 5 ppm of full scale)

DC/DC, AC/DC Ratio. Three-wire or optional four-wire ratio capability permits the 6900 to receive an external DC reference voltage for making DC/DC, AC/DC or mV/DC ratio measurements. This capability permits measurement of transfer functions such as voltage dividers, and amplifier gains with accuracies independent of the excitation voltage stability.

Ohms.

True Four-Wire Sensing. The 6900, equipped with the Model 24 Ohms Converter, provides true four-wire sensing. Separate current and voltage leads are available for the ultimate in ohms accuracy through the elimination of errors caused by input lead resistance. This feature becomes particularly significant in systems applications where leads of various lengths are commonly used.

Unique Ohms Guard. The 6900 has a unique ohms guard which allows certain in-circuit ohms measurements to be made at full accuracy. The measurement of resistor networks (e.g., strain bridges) without the need to disassemble individual resistors or to calculate their values from a series of measurements is now possible. The ohms guard is particularly effective in preventing tribo-electric errors in systems applications where long input leads are utilized.

0.003% Ohms Accuracy. The Model 24 Ohms Converter maintains an accuracy of ±(0.003% of reading + 0.001% of full scale) for 90 days (±5°C) on its .1 kilohm to 1 megohm ranges. This accuracy is achieved by measuring ohms using the Ratiometric technique. This eliminates all sources of error due to reference zener diode drift with time.

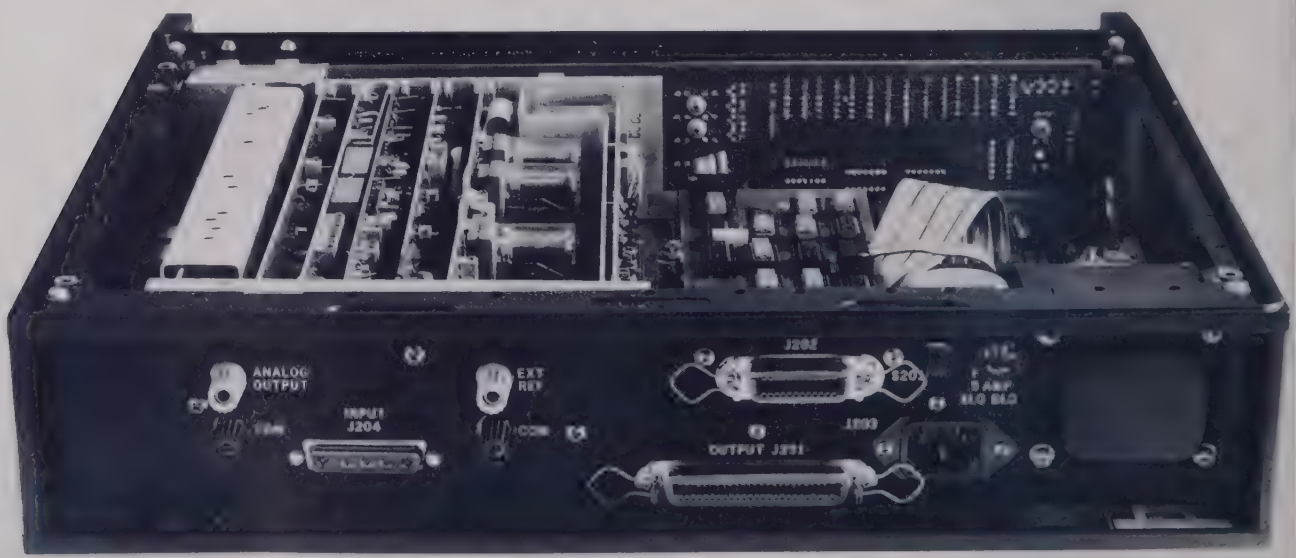
AC Volts.

Broadband AC — 20 Hz to 300 KHz. The Dana Model 10 True RMS AC Converter and Model 14 Average Responding AC Converter (calibrated in rms) have four AC ranges for making accurate measurements over a frequency range from 20 Hz to 300 KHz. These four ranges (1V, 10V, 100V, and 1000V full scale) provide resolution from 10 μV on the 1V range to 10 mV on the 1000V range.

True RMS AC. The Model 10 provides 0.1% typical accuracy over a wide range of crest factors. The converter operates in either the AC Mode or AC + DC mode.

True Systems Compatibility.

General Purpose Interface Bus. To simplify the interconnection of instrumentation built by different manu-



facturers, a standard interface bus was developed and approved as IEEE Std 488-1975. The 6900's Model 55 GPIB meets all the specifications of IEEE Std 488 and can be connected with any other instrumentation equipped with the "bus." Thus, instrumentation systems for lab or production use can now be easily built up with a minimum of effort — because the connectors, wiring, handshaking, and all other aspects of getting the information from one instrument to another have already been designed.

Parallel BCD Output. The 6900's standard parallel BCD output can be easily interfaced to digital recording equipment. TTL compatible output of data are provided. Full isolation is maintained with both double-guarded toroids and an LED/photo transistor technique. This ensures full common mode noise rejection no matter how the instrument is connected into a system.

Remote Programming. The paralleled BCD remote programming option provides full remote control of the 6900. In addition to being fully isolated, the programming function, as well as the output, are fully buffered. Buffering prevents the introduction of noise into the instrument via the input/output lines. In addition the buffered 6900 is protected from damage from accidental grounding of the input/output lines to earth.

User Orientation.

Automatic or Manual Ranges. The 6900 offers either full autoranging or manual selection of any range in any function as a standard feature. Without touching a range control, the operator may read DC from 1μV to 1100V, AC from 10μV to 1000V, and resistance from 100 μohms to 160 megohms.

Failsafe "No" Light. A built-in indicator lights the word "No," in case the 6900 is operating on an illegal range or is not equipped with specific function selected, or is operating in overload. This information is also made available at the BCD output to prevent recording erroneous data.

LED Display. The 6900 is equipped with a highly reliable and long-life LED display that provides six full digits of readout and a seventh digit for 60% overranging.

Leading Zero Suppression. A circuit in the 6900 eliminates all insignificant zeros in the readout. This helps prevent the operator from making erroneous readings, since only meaningful digits are displayed.

Plug-in IC's. The 6900 Digital Multimeter is equipped with IC sockets for accepting plug-in components. Should an integrated circuit malfunction at any time, this built-in feature allows correction by simply plugging in a replacement component. Furthermore, the 6900 uses standard, readily available 7400 TTL integrated circuits. The Series 6900 instruments offer simplicity of design, which makes them easier to maintain. An uncluttered circuitry layout permits easy instrument calibration and fast trouble-shooting. Instructions are printed on the inside cover of the instrument, further facilitating calibration.

Dana Model 6900 Specifications

DC VOLTS
(Included in Basic Instrument)

Ranges:	±.100000V, ±1.000000V, ±10.00000V, ±100.0000V, ±1000.000V
Resolution:	.0001% of range. 100nV on 0.1V range
Overrange:	60% except 1000V range (1100V maximum input)
Maximum Input Voltage:	1100VDC or 1500V peak AC on all ranges
Relative Accuracy: (Basic 6900 DC accuracy, excluding the uncertainties of the DC calibration sources.)	24 hours, 23°C±1°C (no adjustments) 10V range ±(3 ppm of reading + 3 ppm of full scale)* 100-1000V ranges ±(5 ppm of reading + 5 ppm of full scale) 1V range ±(6 ppm of reading + 5 ppm of full scale) .1V range ±(20 ppm of reading + 50 ppm of full scale) 90 days, 23°C±5°C 10V range ±(10 ppm of reading + 6 ppm of full scale) 100-1000V ranges ±(15 ppm of reading + 8 ppm of full scale) 1V range ±(16 ppm of reading + 8 ppm of full scale) .1V range ±(30 ppm of reading + 50 ppm of full scale) 1 year, 23°C±5°C 10V range ±(30 ppm of reading + 8 ppm of full scale) 100-1000V ranges ±(35 ppm of reading + 9 ppm of full scale) 1V range ±(36 ppm of reading + 9 ppm of full scale) .1V range ±(50 ppm of reading + 50 ppm of full scale)
Absolute Accuracy: (Overall 6900 accuracy, including the following uncertainties of the DC sources used during in-house calibrations: .1V: 17 ppm 1V: 4 ppm 10V: 2 ppm 100V: 4 ppm 1000V: 10 ppm)	24 hours, 23°C±1°C (no adjustments) 10V range ±(5 ppm of reading + 3 ppm of full scale) 100V range ±(9 ppm of reading + 5 ppm of full scale) 1000V range ±(15 ppm of reading + 5 ppm of full scale) 1V range ±(10 ppm of reading + 5 ppm of full scale) .1V range ±(37 ppm of reading + 50 ppm of full scale) 90 days, 23°C±5°C 10V range ±(12 ppm of reading + 6 ppm of full scale) 100V range ±(19 ppm of reading + 8 ppm of full scale) 1000V range ±(25 ppm of reading + 8 ppm of full scale) 1V range ±(20 ppm of reading + 8 ppm of full scale) .1V range ±(47 ppm of reading + 50 ppm of full scale) 1 year, 23°C±5°C 10V range ±(32 ppm of reading + 8 ppm of full scale) 100V range ±(39 ppm of reading + 9 ppm of full scale) 1000V range ±(45 ppm of reading + 9 ppm of full scale) 1V range ±(40 ppm of reading + 9 ppm of full scale) .1V range ±(67 ppm of reading + 50 ppm of full scale)
Temperature Coefficient:	0°C to 50°C 10 Volt Range ±(1.5 ppm of reading + .5 ppm of full scale)/°C 1-1000 Volt Range ±(3 ppm of reading + 1 ppm of full scale)/°C 0.1 Volt Range ±(4 ppm of reading + 5 ppm of full scale)/°C
Input Impedances:	0.1V-10V >100,000 MΩ 100V-1000V >10 MΩ

DC VOLTS cont'd.

*FULL-SCALE is defined as 100% of range, e.g. "1000000" reading on any range is full scale.

DC VOLTS cont'd.

Input Bias Current:	10 pA at time of calibration (±100 pA for 30 days at 25°C)
Input Bias Current Temperature Coefficient:	±5 pA/°C
Normal Mode Rejection:	
Unfiltered	54 dB at every multiple of 60 Hz
Filtered	100 dB at 60 Hz
Common Mode Rejection:	(with 100Ω unbalance in either lead)
Unfiltered	140 dB at DC, 120 dB at 61 Hz and below plus an additional 54 dB at harmonics of 60 Hz
Filtered	140 dB DC to 61 Hz 126 dB 61 Hz to 100 kHz
Settling Time:	
Unfiltered	Settles to within 0.01% in 5 msec with 10 KΩ source, 10 msec on 100V range
Filtered	Settles to within 0.01% in 450 msec with 10 KΩ source

AC VOLTS
TRUE RMS (Option 10)

Ranges:	1.00000V, 10.0000V, 100.000V, 1000.00V rms
Resolution:	0.001% of range 10μV on 1V range
Overrange:	60%, (within max. input voltage limit)
Maximum Input Voltage:	1000V DC/rms or 1500V peak, decreasing to 20V rms at 1 MHz. 2 x 10^7 VHz maximum on any range.
Maximum Crest Factor: (Pulses at 1 kHz Repetition Rate)	7:1 at full scale $7 \times \sqrt{\frac{\text{F.S.}}{\text{V input}}}$ for other voltages
Accuracy:	90 days, 23°C ± 5°C
AC Mode	20 Hz to 30 Hz (filtered) ±(.5%R + .04% FS) 30 Hz to 50 Hz (filtered) ±(.2%R + .04% FS) 50 Hz to 100 Hz (filtered) ±(.1%R + .04% FS) 100 Hz to 20 kHz (filtered) ±(.06%R + .04% FS) 200 Hz to 20 kHz (no filter) ±(.06%R + .04% FS) 20 kHz to 50 kHz (both) ±(.1%R + .1% FS) 50 kHz to 100 kHz (both) ±(.4%R + .2% FS) 100 kHz-300 kHz, 10, 100, 1000V range ±(3%R + .5% FS) 100 kHz-300 kHz 1V range ±(5%R + 1% FS)
AC & DC Mode	Add ±.02% FS to AC specification
For inputs greater than 500V Add 1%R	
Temperature Coefficient:	0°C to 50°C AC Mode (to 20 kHz) ±(.004%R + .003% FS)/°C AC & DC Mode (to 20 kHz) ±(.004%R + .005% FS)/°C
Input Impedances:	1 Megohm ± 0.1% in series with 0.22μF
AC Mode	shunted by less than 100 pF to common

Common Mode Rejection: with 100 ohm unbalance in either lead. DC to 60 Hz	Range	CMR
	1V	120 dB
	10V	100 dB
	100V	80 dB
	1000V	60 dB

Settling Time:	(to within .1% of range)	Filter Out	Filter In
	0 to Full Scale Step	80 mSec	350 mSec
	Full Scale to 10% FS Step	100 mSec	400 mSec

AC VOLTS
(Option 14 AC Converter, Averaging)

Ranges:	1.00000V, 10.0000V, 100.000V, 1000.00V rms
Resolution:	0.001% of range 10μV on 1V range
Overrange:	60% except 1000V range (1000V rms maximum input)
Maximum Input Voltage:	1000V rms or 1500V peak, decreasing to 20V rms at MHz. 2x10^7V Hz maximum on any range
Accuracy:	24 hours, 23°C±1°C
1mV≤E_{in}≤500V	20 Hz to 30 Hz (filtered) ±(0.2% of reading + 0.002% of full scale) 30 Hz to 60 Hz (filtered) ±(0.1% of reading + 0.002% of full scale) 60 Hz to 100 Hz (filtered) ±(0.05% of reading +0.002% of full scale) 100 Hz to 5 kHz (filtered) ±(0.02% of reading +0.002% of full scale) 100 Hz to 300Hz (no filter) ±(0.1% of reading + 0.002% of full scale) 300 Hz to 5 kHz (no filter) ±(0.02% of reading + 0.002% of full scale) 5 kHz to 100 kHz (both) ±(.04% of reading +0.005% of full scale) 100 kHz to 300 kHz (both) ±(0.1% of reading +0.01% of full scale) 90 days, 23°C±5°C add ±0.01% of reading to 24 hour specification 6 months, 23°C±5°C add ±0.02% of reading to 24 hour specification
E_{in}>500V	f<5 kHz add ±.1% of reading f≥5 kHz add ±.2% of reading
Temperature Coefficient:	0°C to 50°C 50 Hz to 20kHz (filtered) ±(0.003% of reading +0.0005% of full scale)/°C 20 kHz to 100 kHz (both) ±(0.005% of reading +0.002% of full scale)/°C 100 kHz to 1 MHz (both) ±(0.01% of reading +0.01% of full scale)/°C
Input Impedances:	1 MΩ ±0.1% in series with 0.22 μF shunted by less than 100 pF to common
Common Mode Rejection:	(with 100Ω unbalance in either lead, DC to 60Hz) 1 Volt Range 120 dB 10 Volt Range 100 dB 100 Volt Range 80 dB 1000 Volt Range 60 dB
Settling Time:	
Unfiltered	Settles to within rated accuracy in 200 msec
Filtered	Settles to within rated accuracy in 600 msec
(Zero to full scale or full scale to 10% of full scale)	

OHMS
(Option 24)

Ranges:	.1000000 KΩ, 1.000000 KΩ, 10.00000 KΩ, 100.0000 KΩ, 1000.000 KΩ, 10.00000 MΩ, 100.0000 MΩ
Resolution:	.0001% of range 100 μΩ on .1KΩ range
Overrange:	60% on all ranges
Maximum Input Voltage:	±500V peak on all ranges
Measurement Scheme:	True 4-wire
Accuracy:	24 hours, 23°C ±1°C .1—1000 kilohm Range ±(0.002% reading +0.001% of full scale) 10 megohm Range ±(0.01% of reading +0.001% of full scale) 100 megohm Range ±(0.03% of reading +0.001% of full scale) 90 days, 23°C ±5°C .1—1000 kilohm Range ±(0.003% of reading +0.001% of full scale) 10 megohm Range ±(0.03% of reading +0.001% of full scale) 100 megohm Range ±(0.03% of reading +0.001% of full scale)
Temperature Coefficient:	0°C to 50°C .1—1 kilohm Range ±(7 ppm of reading +1 ppm of full scale)/°C 10—1000 kilohm Range ±(6 ppm of reading +1 ppm of full scale)/°C 10 megohm Range ±(30 ppm of reading +1 ppm of full scale)/°C 100 megohm Range ±(50 ppm of reading +3 ppm of full scale)/°C
Open Circuit Voltage:	.1KΩ—1 KΩ 10V maximum 10 KΩ—100 MΩ 22V maximum
Current Through Unknown:	.1 kilohm Range 11.1111 mA 1 kilohm Range 1.11111mA 10 kilohm Range 1 mA 100 kilohm Range 100 μA 1000 kilohm Range 10μA 10 megohm Range 1 μA 100 megohm Range 100 nA
Normal Mode Rejection:	
Unfiltered	58 dB at every multiple of 10 Hz
Filtered	100 dB at 60 Hz
Common Mode Rejection:	(with 100Ω unbalance in either lead)
Unfiltered	140 dB at DC, 120 dB at 61 Hz plus an additional 54 dB at harmonics of 60 Hz
Filtered	140 dB DC to 61 Hz 120 dB 61 Hz to 100 kHz
Settling Time:	
to rated accuracy	.1KΩ—10 MΩ 30 msec 100 MΩ 300 msec
Ohms Guard:	Use "Analog-Out" low on rear panel when in ohms

3-WIRE RATIO
(Included in Basic Instrument)

3-Wire (Standard)	ac/dc, dc/dc, and mV/dc
Readout:	$\frac{(10V)}{(Ref\ V)} \times \frac{(Input)}{(F.S.\ of\ range)} \times 10$
Reference Voltage Range:	+1V to +10.5V
Maximum Input Voltage:	Same as function
Accuracy:	24 hours, 23°C ±1°C DC, AC—same as respective 24 hour, 23°C ±1°C spec. times $\frac{(10V)}{(Ref\ V)}$
Reference Input Impedance:	100 MΩ
Reference Settling Time:	One second to 0.01% accuracy

4-WIRE RATIO
(Option 34)

4-Wire (Option 34)	ac/dc, dc/dc, and mV/dc
Readout:	$\frac{(10V)}{(Ref\ V)} \times \frac{(Input)}{(F.S.\ of\ range)} \times 10$
Reference Voltage Range:	+1V to +10.5V
Maximum Input Voltage:	Same as function
Accuracy:	24 hours, 23°C ±1°C DC, AC—same as respective 24 hour, 23°C ±1°C spec. times $\frac{(10V)}{(Ref\ V)} \times 2$
Reference Input Impedance:	(Both leads with respect to —sig. input) 100 MΩ min. + lead 10 MΩ ± 10% — lead
Reference Input to Sig. Common Voltage:	±15V max. (either input)
Reference Settling Time:	50 msec to 0.01% of rated accuracy

GENERAL

Conversion Technique:	Delayed Dual Slope
Signal Integration Time:	100 msec 1 msec in Superfast
Reference Integration Time:	0-160 msec
Polarity Selection:	Automatic
Ranging:	Autoranging is standard, up-ranges at 160% F.S. and downranges at 15% F.S.
Read Rate:	2 rdg per sec minimum to hold
Maximum Common Mode Voltage:	1000V peak or DC Guard to case with logic common tied to case. 250V analog common to guard
Display:	6 full decades plus overrange digit (LED .3 inches high) plus decimal point and function annunciator
Overrange Indication:	Maximum reading is 1600000 and "NO" annunciator is illuminated.
Filter:	4-pole active
Analog Signal Output:	Input scaled and buffered 0 to ±16V. DC voltage equal to the readout is available for driving a recorder or as an accurate voltage source
Power Requirement:	115 or 230V ±10% 50-60 Hz Standard 400 Hz Optional 40 watts maximum
Weight:	16 lbs. (7.3 Kg)
Dimensions:	3.5"x14"x16.75" (89 mm x 356 mm x 425 mm)
Temperature Range:	Operating 0°C-50°C Storage —40°C-70°C
Humidity Operating:	<75%; 25°C-40°C <50%; 40°C-50°C
Fan:	None required
Vibration, Operating:	0.025" double amplitude to 50 Hz for 15 minutes
Warm-up:	
To 24 hour specs:	2 hours
To 6 month specs:	1 hour

DATA OUTPUT
(Included in the Basic Instrument)

Information:	All BCD outputs of display, 4-bit range code, function flags, polarity flags, special flags, and logic supplies
Logic Type:	Standard TTL levels, 8-4-2-1 BCD
Input Commands:	Superfast Data Disable System Direct Command
Maximum Read Rate:	3-1/3 per sec to full scale, 140 per sec to full scale in Superfast
Isolation:	Data output common may be floated up to 200V peak from power line common

HOW TO ORDER INSTRUMENTS AND ACCESSORIES

To order the 6900 Precision Voltmeter, provide a complete model number, indicating both the basic instrument and all options and accessories that are to be included. The total cost is the sum of the individual items ordered.

Refer to Dana's Master Price List when ordering options and accessories separately.

BASIC INSTRUMENT

Model 6900 Precision Voltmeter
(includes DCV, 3-wire ratio, BCD output, analog output, parallel front and rear signal inputs) $4995
Option 71 230V Operation . . . . . N/C
Option 04 50 Hz Operation . . . . . N/C

Optional Functions and Programming

Option 09 Accessory Card $150
*Option 10 True RMS AC Converter $475
*Option 14 AC Converter, Averaging $575
*Option 24 4-wire Ohms $350
Option 34 4-wire Ratio $200
Option 50 Remote Programming $300
†Option 55 GPIB $850
Option 60 Rack Mounting Flanges for 6900 . . . . . $ 20
Option 62 Rack Mounting Flanges for GPIB . . . . . $ 20

*Requires Option 09
†Requires Option 50

Miscellaneous Accessories

Input Cable, Part No. 402190 . . . . . $ 20
High Voltage Probe (10KV), Model 641 . . . . . $275
Current Shunts Model 651 . . . . . $125
Extender Card, Part No. 403644 . . . . . $ 30

Prices and specifications subject to change without notice. Payable in U.S. Funds.

YOUR NEAREST DANA REPRESENTATIVE:

REMOTE PROGRAMMING
(Option 50)

Input Information:	Provides isolated programming of all DMM functions and ranges
Logic Type:	Standard TTL levels, 8-4-2-1 BCD
Functions:	Function lines are programmed by a closure to ground (low TTL level)
Ranges:	Range lines are 8-4-2-1 coded positive true logic
Command Modes:	Direct Command Timeout Command Superfast

GENERAL PURPOSE INTERFACE BUS (GPIB)
(Option 55)

The Model 55 Microprocessing GPIB enables the Dana Series 6900 Precision Voltmeters to be interfaced with other instrumentation and control devices utilizing the "standard interface bus" structure. The Model 55 Microprocessing GPIB is completely self-contained in a 1¾ inch high, rack mountable, piggyback package. It is compliant with IEEE Std 488-1975, "IEEE Standard Digital Interface for Programmable Instrumentation." All connectors and cabling to connect the Model 55 with the 6900 are provided as well as the standard connector to connect with the "bus."

Output Information:	Numeric data, polarity, function, and special flags.
Data Output Format:	DC, AC, Ratio: same as front panel display with no leading zero suppression. Ohms: readout expressed as kohms.
Input Information:	Functions, ranges, and filter.
Command Modes:	Direct Command Timeout Command Superfast
Electrical Compatibility:	IEEE Std 488-1975
Information Format:	7-bit ASCII code
Power Requirement:	20 Watts Maximum
Line Voltage:	100/120/220/240V ±10%, 48—440 Hz
Weight:	3.2 Kg (7 lb)
Dimensions:	44mm x 356mm x 425mm (1.75" x 14" x 16.75")

SUPERFAST

Ranges & Functions:	All ranges and functions
Command:	Must be commanded through rear printer connector (J201), through programmer option (J202), or through the GPIB.
Display:	Four-digit display with 60% overrange
Maximum Read Rate:	130 readings/sec. minimum at full overrange. 140 readings/sec. at full scale
Accuracy:	Standard accuracy for range and function plus .03% of reading plus .03% of full scale

DANA®
Dana Laboratories, Inc.,
2401 Campus Drive,
Irvine, California 92713.
Telephone (714) 833-1234, Teletype 910-595-1136, Telex 67-

Series 5100 Digital Multimeter

DANA®

Others measure by us.

- ☐ 4 measurement functions
  - DC volts (1μV sensitivity)
  - AC volts (Averaging or True RMS)
  - Ohms (1mΩ-20MΩ)
  - Frequency (10Hz-20MHz)
- ☐ 5½ digit accuracy guaranteed *for a full year*
- ☐ Switchable 3-pole active filter
- ☐ 100,000MΩ input impedance on the .2-200V ranges
- ☐ Large yellow LED readout
- ☐ BCD output
- ☐ Read/hold probe

Like all Dana instruments, the Series 5100 5½ digit multimeter is designed to give you the maximum of measuring capability and the minimum of trouble. It is the most reliable and the most versatile unit in its price class. Accuracy specs are good *for a full year without recalibration,* which gives you considerably more service per dollar than any other unit made. And with the extensive features of the 5100, you don't have to compromise capability for price.

The unit comes standard with Averaging AC voltage measurement, but you can specify True RMS if you need it.

The built-in switchable filter gives you an extremely sensitive 3-pole filter for excellent noise rejection. When you don't need a filter, you can switch it off and get extremely fast settling times.

Built-in frequency measurement capability allows you to measure frequencies from 10Hz up to 20MHz without having to hunt for or hook up a separate instrument.

Large yellow LED readouts reduce eyestrain. They won't "blossom" with long exposure, as will red LEDS.

The exceptionally high 100,000MΩ input impedance on four of the DC voltage ranges assures you of accurate measurement without loading error.

An optional read/hold probe allows you to make measurements in dangerous fields without taking your eye off the probe. It lets you take precise measurements in tight places without fear of error. And it allows you to record only significant readings when making a permanent record.

Throughout the unit, every detail has been planned to make your job easier and to give you exactly the kind of precise, trouble-free measurement you need.

The Series 5100 5½ digit multimeter is the result of our very long tradition of designing and building uncompromising measurement instrumentation. Because we've been doing it for so long, we've learned how to give you the very best instrumentation for very little more than merely adequate equipment.

We think you'll find there is nothing else on the market quite like the 5100 digital multimeter for anywhere near the price.

Data Model 5100 Specifications

DC VOLTS

Ranges:	±.200000V, ±2.00000V, ±20.0000V, ±200.000V, ±1200.00V	
Maximum Resolution:	1μV on 0.2V range	
Maximum Input Voltage:	1200V peak	
Accuracy:	24 hours, 23°C ±1°C	
	0.2V, 1200V:	±(0.003% Rdg. + 4 Counts)
	2V, 20V, 200V:	±(0.0025% Rdg. + 2 Counts)
	90 days, 23°C ±5°C	
	0.2V:	±(0.006% Rdg. + 8 Counts)
	2V, 20V, 200V:	±(0.004% Rdg. + 2 Counts)
	1200V:	±(0.008% Rdg. + 4 Counts)
	1 year, 23°C ±5°C	
	0.2V:	±(0.009% Rdg. + 8 Counts)
	2V, 20V, 200V:	±(0.008% Rdg. + 2 Counts)
	1200V:	±(0.02% Rdg. + 4 Counts)
Temperature Coefficient:	0°C-50°C	
	0.2V:	±(0.0005% Rdg. + 1 Count)/°C
	2V, 20V, 200V:	±(0.0005% Rdg. + .4 Count)/°C
	1200V:	±(0.0015% Rdg. + .4 Count)/°C
Input Impedance:	0.2V, 2V, 20V,	
	200V:	100,000MΩ
	1200V:	10MΩ
Normal (Series) Mode Noise Rejection:	Unfiltered:	>20dB at 45Hz >60dB at 50 & 60Hz
	Filtered:	>75dB at 45Hz >120dB at 50 & 60Hz
Common Mode Noise Rejection: (with 1KΩ unbalanced in either lead)	Unfiltered:	>140dB at DC >120dB at 50 & 60Hz
	Filtered:	>140dB at DC >180dB at 50 & 60Hz
Selectable Filter:	3-pole active filter	
Settling Time: (to within 0.01% of range)	Unfiltered:	30ms
	Filtered:	500ms

AC VOLTS

Averaging AC Calibrated rms

Ranges:	2.00000V, 20.0000V, 200.000V, 1000.00V rms	
Maximum Resolution:	10μV on 2V range	
Maximum Input Voltage:	1000V rms, 1500V peak, decreasing to 20V rms at 1MHz. 2×10^7 VHz product maximum on any range	
Accuracy:	1 year, 23°C ±5°C (.1% to 100% of range)	
	2V-200V:	
	30-50Hz	±(1.1% Rdg. + 60 Counts)
	50-100Hz	±(0.35% Rdg. + 20 Counts)
	100-10KHz	±(0.2% Rdg. + 10 Counts)
	10K-20KHz	±(0.35% Rdg. + 20 Counts)
	20K-100KHz	±(1.1% Rdg. + 60 Counts)
	1000V (0-500V):	
	30-100Hz	±(0.35% Rdg. + 40 Counts)
	100-10KHz	±(0.25% Rdg. + 40 Counts)
	10K-20KHz	±(0.35% Rdg. + 40 Counts)
	1000V (500-1000V):	
	30-100Hz	±(0.6% Rdg. + 40 Counts)
	100-10KHz	±(0.4% Rdg. + 40 Counts)

AC VOLTS (Cont)

Accuracy (Cont):	10K-20KHz	±(60% Rdg. + 40 Counts)
	90 days, 23°C ±5°C (.1% to 100% of range)	
	All frequencies and ranges: substract ±0.1% Rdg. from the 1 year specification	
Temperature Coefficient:	±(0.008% Rdg. + 2 Counts)/°C	
Input Impedance:	2MΩ || 100pF	
Common Mode Noise Rejection: (with 1KΩ unbalance in either lead)	80dB, DC to 60Hz	
Filter:	The selectable active filter is automatically engaged whenever the AC function is selected	
Settling Time:	1 second maximum	

True RMS (Option 10)

Ranges:	2.00000V, 20.0000V, 200.000V, 1000.00V rms	
Maximum Resolution:	10μV on 2V range	
Maximum Input Voltage:	1000V rms, 1500V peak, decreasing to 20V rms at 1MHz. 2×10^7 VHz product maximum on any range	
Accuracy: AC + DC Mode:	1 year, 23°C ±5°C (1% to 100% of range)	
	2V:	
	30-100Hz	±(0.45% Rdg. + 700 Counts)
	100-5KHz	±(0.25% Rdg. + 700 Counts)
	5K-50KHz	±(0.45% Rdg. + 700 Counts)
	50K-100KHz	±(0.65% Rdg. + 900 Counts)
	100K-200KHz	±(5.15% Rdg. + 800 Counts)
	200K-300KHz	±(10.15% Rdg. + 1300 Counts)
	20V-1000V:	
	30-100Hz	±(0.45% Rdg. + 700 Counts)
	100-20KHz	±(0.25% Rdg. + 500 Counts)
	20K-50KHz	±(0.35% Rdg. + 700 Counts)
	50K-100KHz	±(0.45% Rdg. + 700 Counts)
	100K-200KHz	±(5.15% Rdg. + 800 Counts)
	200K-300KHz	±(10.15% Rdg. + 1300 Counts)
	90 days, 23°C ±5°C (1% to 100% of range)	
	All frequencies and ranges: substract ±(0.15% Rdg. + 300 Counts) from the 1 year specification	
Temperature Coefficient:	±(0.008% Rdg. + 8 digits)/°C	
Input Impedance:	1MΩ||100pF	
Crest Factor:	5 : 1 maximum at full scale	
	$5 \times \sqrt{\frac{\text{full scale of range}}{\text{reading}}}$ for other voltages	
Common Mode Noise Rejection: (with 1KΩ unbalance in either lead)	80dB, DC-60Hz	
Filter:	The selectable active filter is automatically engaged whenever the AC function is selected	
Settling Time:	1 second maximum	

OHMS

Ranges:	200Ω, 2,000Ω, 20,000Ω, 200,000Ω, 2MΩ, 20MΩ, 200MΩ	
Maximum Resolution:	1mΩ on 0.2KΩ range	
Maximum Input Voltage:	250V rms continuous (±350V peak) on all ranges	
Measurement Scheme:	True 4-wire	
Accuracy:	90 days, 23°C ±5°C	
	0.2KΩ, 2,000KΩ:	±(0.007% Rdg. + 6 Counts)
	2KΩ-200KΩ:	±(0.006% Rdg. + 6 Counts)
	20,000KΩ:	±(0.02% Rdg. + 6 Counts)
	1 year, 23°C ±5°C	
	0.2KΩ, 2,000KΩ:	±(0.013% Rdg. + 6 Counts)
	2KΩ-200KΩ:	±(0.01% Rdg. + 6 Counts)
	20,000KΩ:	±(0.03% Rdg. + 6 Counts)
Temperature Coefficient:	0°C-50°C	
	0.2KΩ, 2,000KΩ:	±(0.0012% Rdg. + .6 Counts)/°C
	2KΩ-200KΩ:	±(0.001% Rdg. + .6 Counts)/°C
	20,000KΩ:	±(0.003% Rdg. + .6 Counts)/°C
Maximum Open Circuit Voltage:	5V	
Current Through Unknown:	0.2KΩ:	1mA
	2KΩ:	1mA
	20KΩ:	100μA
	200KΩ:	10μA
	2,000KΩ:	1μA
	20,000KΩ:	100nA
Normal (Series) Mode Noise Rejection:	Same as DC Volts	
Common Mode Noise Rejection:	Same as DC Volts	
Settling Time: (to within 0.01% of range)	Unfiltered:	
	0.2KΩ-200KΩ:	30ms
	2,000KΩ:	50ms
	20,000KΩ:	200ms
	Filtered:	Add 5 x R seconds to unfiltered settling time where R is range selected in MΩ

FREQUENCY

Ranges:	2000.00KHz, 20000.0KHz	
Maximum Resolution:	10Hz	
Accuracy:	90 days, 23°C ±5°C ±(0.006% Rdg. + 4 Counts)	
	1 year, 23°C ±5°C ±(0.01% Rdg. + 4 Counts)	
Input Characteristics:		
Sinewave Sensitivity:	350mV rms to 20MHz	
Input Impedance:	500KΩ//100pF	
Maximum Input Voltage:	350V rms (±500V peak)	
Measurement Time:	2000KHz range: .1s	
	20000KHz range: .1s with divide by 10 prescaler	

CURRENT

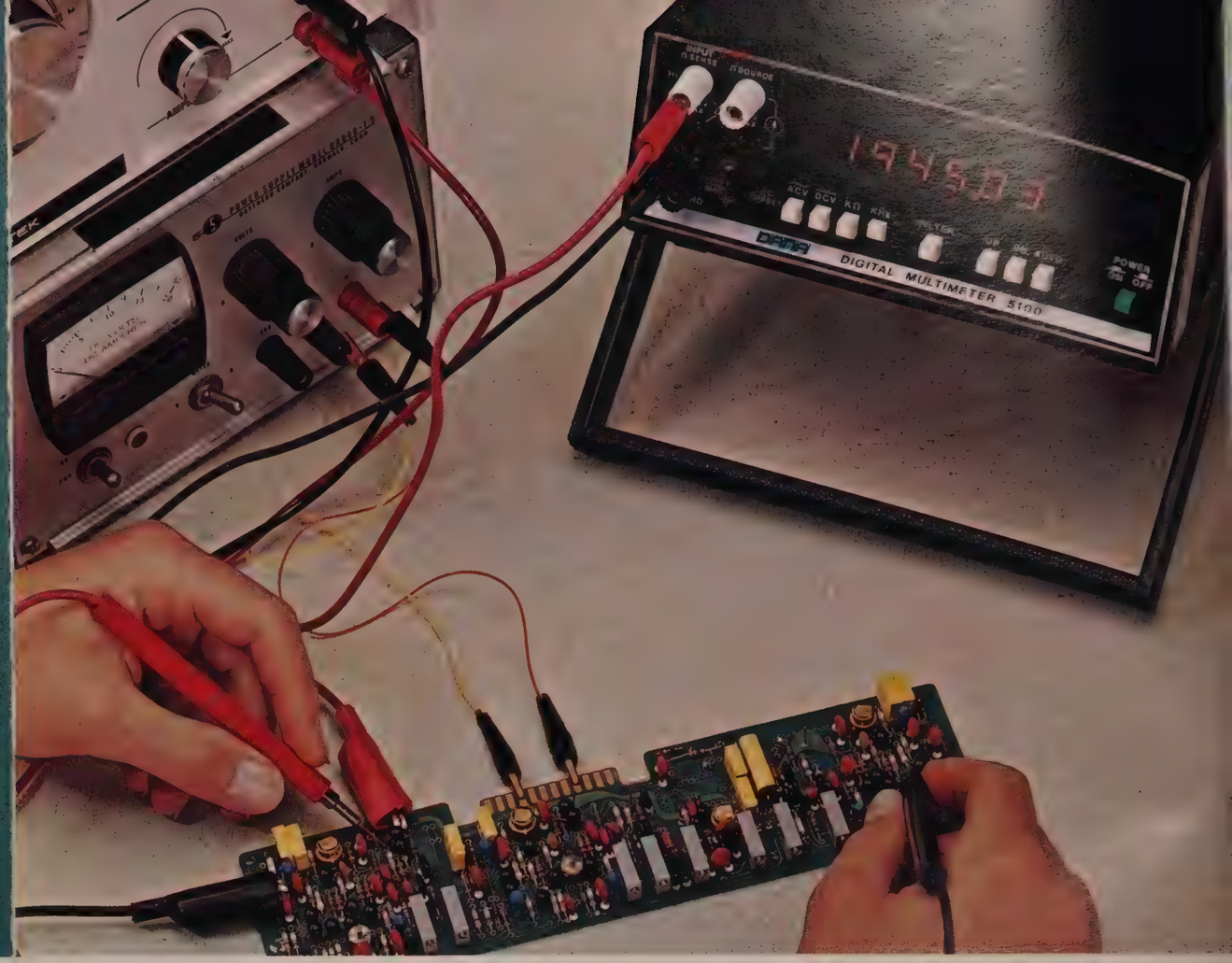
Ranges:	2m, 20m, 200m, 2A, 200μA	
Maximum Resolution:	1nA on 2m range	
Accuracy:		
DC Current:	0.01% plus DC Volts accuracy (0.07% on 2A range)	
AC Current:	2m-2A ranges	
	50Hz-10KHz 0.2% plus ACV accuracy	
	200μA range	
	50Hz-1KHz 0.65% plus ACV accuracy	
Overload:	1 watt or 250V peak whichever occurs first	

GENERAL

Maximum Counts:	200,000
Display:	5 full decades plus overrange digit (.43 inch (1.1cm) high LEDs), polarity announciator and automatic decimal point
Read Rate:	2.5 readings per second
Ranging:	Manual and automatic. Up ranges automatically at 200,000 counts and down ranges at 10,000 counts
Overrange Indication:	"200000" flashing on display
Maximum Common Mode Voltage:	1000V between guard and earth ground 200V between "—" input and guard
Power Requirement:	100, 120, 220, 240V±10%; 50-400Hz; 22 watts maximum
Weight:	3Kg (6.6 lbs.)
Dimensions:	Height x Width x Depth 73 x 200 x 250 mm 2.87 x 7.87 x 9.84 inches
Warm up Time:	30 minutes to full accuracy
Operating Temperature:	0°C to +50°C
Storage Temperature:	—40°C to +75°C
Warranty:	12 months – repair or replace malfunctions due to faulty workmanship or component failure

DATA OUTPUT (Option 51)

Information:	Numeric BCD output in both parallel and byte serial mode, range, function, and DATA VALID lines.
Logic Type:	Standard TTL levels, 8-4-2-1 BCD
Input Command:	Single read/hold line
Isolation:	1000V peak between Data Output and Analog Commons
Auxiliary Output Voltage:	+5V DC ±10%, 50mA
Data Output Connector:	PCB edge connector (Amp #583718-9) supplied with option



OPTIONS AND ACCESSORIES

51 - BCD Output (not shown)
The isolated BCD output provides numeric and polarity information to printers or other digitally operated equipment. The output is completely isolated, preserving the instrument's common mode noise rejection characteristics, even when connected to grounded equipment. The output connector provided is an Amp #583718-9 (Dana P/N 403920) PCB edge connector.

60 - Rack Mounted Flanges (not shown)
Permits the 5100 to be left-or right-hand mounted in a standard 19 inch, 3-1/2 inch high instrument rack.

80 - Input Cable
This is a 5 foot long shielded cable with hooded alligator clip probes and dual banana plug for mating the cable to the instrument. Especially useful in high noise environments.

81 - Read/Hold Probe
A button on the probe allows the operator to push to hold or push to read a measurement. The probe can handle up to 500V DC or AC rms.

82 - High Voltage Probe, 5KV
Extends the DC measurement capability of the instrument to 5000 volts.

Accuracy	(0-5KV, 0 to +50°C) ±2% of input with 10Mohms DMM load
Maximum Input	5KV DC
Input Resistance	900Mohms nominal
Division Ratio	1000:1

83 - High Voltage Probe, 50KV
Extends the DC measurement capability of the instrument to 50,000 volts.

Accuracy	(0-45KV, 0 to +50°C) ±5% of input with 10Mohms DMM load
Maximum Input	50KV DC
Input Resistance	900Mohms nominal
Division Ratio	1000:1

84 - R.F. Probe, 200MHz
Extends the capabilities of the instrument to the measurement of RF frequency, from 1kHz to 200MHz at rms voltage levels up to 30 volts. The probe converts the RF signal to the DC equivalent voltage.

Accuracy	±5°C, 6 mos., 0-25V rms
1KHz to 10MHz	±(1% input +50mV)
10MHz to 100MHz	±(1dB input +50mV)
100MHz to 200MHz	±(3dB input +50mV)
Input Impedance	1.6Mohm || 7pF
Maximum Input	125Vrms AC, 60-400Hz, 250VDC

85 - Current Shunts
Six precision shunt resistors housed in a wooden box extends the 5100's measurement capability to include DC and AC current measurement. See "Specifications".

88 - Deluxe Test Lead Set
Designed to withstand the everyday, continuous on-the-line use in production testing or field use. The probes come equipped with assorted tips and carrying case.

89 - Standard Test Lead Set (not shown)
Standard test leads with 90 degree banana plugs and replaceable "phonograph needle" tips.

90—R.F. Probe, 520MHz (not shown)
Extends the capabilities of the instrument to the measurement of RF frequency from 100KHz to 520MHz at rms voltage levels up to 30 volts. The probe converts the RF signal to the DC equivalent voltage.

Accuracy	
100KHz to 200MHz	±1dB input
200MHz to 520MHz	±3dB input
Input Impedance	2Mohm || 4pF
Maximum Input	200VDC

HOW TO ORDER INSTRUMENTS AND ACCESSORIES

The 5100 Digital Multimeter can be ordered from your local Dana representative or directly from the factory. To order, provide a complete model number, indicating both the basic instrument and all options and accessories that are to be included. The total cost is the sum of the individual items ordered.

5100	5-1/2 digit DMM, 5 DC, 4 AC, 6 ohm, and 2 frequency ranges	$1,145
Options		
04	50Hz operation	N/C
71	230V operation	N/C
10	True RMS AC voltage measurement capability instead of Averaging AC	$125
16	Omit AC measurement capability	less $150
51	BCD Output	$195
Accessories		
80	Input Cable	$ 25
81	Read/Hold Probe	$ 50
82	High Voltage Probe, 5kV	$ 40
83	High Voltage Probe, 50kV	$
84	R.F. Probe, 200MHz	$
85	Current Shunts	$
88	Deluxe Test Lead Set	$
89	Standard Test Lead Set	$
90	R.F. Probe, 520MHz	$

YOUR NEAREST DANA REPRESENTATIVE:

Prices and specifications subject to change without notice.

DANA®

Dana Laboratories, Inc.
2401 Campus Drive, Irvine, CA 92715, U.S.A.
Telephone 714/833-1234, Teletype 910-595-1136, Telex 678-341

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BB6346 1-76 5
Printed in U.S

Series 5900
Digital Multimeter

DANA

Others measure by us.

The 5900. A new standard for accuracy and stability.

It may well be the world's most accurate and stable five-digit voltmeter. One with greater than 10,000 megohm input resistance. Delayed dual slope. It offers five DC ranges, 60% overrange, and full ratio capability. Plus 0.03% AC accuracy and the flexibility of two measurement speeds for AC voltages.

The 5900 provides true four-wire ohms sensing and true systems capability, full autoranging, and LED readout.

Accuracy.

0.001% DC Accuracy. The basic 5900 maintains ±0.001% of full scale accuracy on its ten volt range for 24 hours, and ±(0.001% of reading + 0.001% of full scale) for 90 days and over a 10°C temperature span.

Greater than 10,000 Megohm Input Resistance. Accuracy in the 5900 is further enhanced by the input impedance capability to prevent less than 0.001% loading error from up to a 100 kilohm source. In addition, "kickback" current to the source has been eliminated through the use of an isolator, thus enabling measurement of capacitive sources, such as filter outputs. The input impedance does not change during any part of the reading cycle.

Delayed Dual Slope. To extract the fullest practical potential from the dual slope integrator design, a 200-count delay is inserted between the signal integration period and the reference integration period. This results in extremely high linearity, coupled with a bandwidth limited null detector with extremely low noise characteristics. In addition, the integrator incorporates automatic zeroing circuitry to further assure 0.001% accuracy.

DC Volts.

1 μV Resolution. The Basic 5900 includes five DC ranges (0.1V, 1V, 10V, 100V, and 1000V), which provide a maximum resolution of 1 μV on the 0.1V range. Furthermore, the settling time is only 5 mSec (10 mSec on 100V range).

60% Overrange. The 5900 provides 60% overrange capability in all functions. This means that many measurements can be made with six-digit resolution (i.e., the 5900 reads 16.0000, where other five-digits read 016.000).

Full Ratio Capability. Easily accessible terminals are mounted on the rear panel of the 5900 to receive an external DC reference voltage for making real time DC/DC, AC/DC, and mV/DC ratio measurements. This standard

capability permits measurement of transfer functions such as voltage dividers, and amplifier gains with accuracies independent of the stability of the excitation voltage. As an option, true four-wire ratio measurement capability is also available on the 5900.

AC Volts.

Broadband AC – 20 Hz to 1 MHz. The Dana Model 33 Averaging AC Converter has four AC ranges for making accurate measurements over a frequency range from 20 Hz to 1 MHz. The Model 32 True rms AC Converter provides accurate measurements from 20 Hz to 300 kHz.

True rms AC – The Model 32 provides 0.1% typical accuracy over crest factors ranging from 7 to 22. The converter operates in either the AC Mode or AC + DC Mode.

0.03% AC Accuracy. The Model 33 maintains an accuracy over a frequency range of 100 Hz to 20 kHz of ±(0.03% of reading + 0.002% of full scale) for 90 days ±5°C.

Two-Speed Measurement Capability. Depending on your measurement requirements, the 5900 provides the flexibility of two measurement speeds for AC voltages. With the filter in, the input settles to within its rated accuracy in 400 mSec for the Model 32 and 600 mSec for the Model 33. However, with the filter out, the input settles to within its rated accuracy in 100 mSec for the Model 32 and 200 mSec for the Model 33.

Ohms.

True Four-Wire Sensing. The 5900 equipped with the Model 52 Ohms Converter, provides true four-wire sensing. Separate current and voltage leads are available for the ultimate in ohms accuracy through the elimination of errors caused by input lead resistance. This feature becomes particularly significant in systems applications where leads of various lengths are commonly used.

0.003% Ohms Accuracy. The Model 52 Ohms Converter maintains an accuracy of ±(0.003% of reading + 0.001% of full scale) for 90 days (±5°C) on its .1 kilohm to 1 megohm ranges. This accuracy is achieved by measuring ohms using the Ratiometric® technique. This eliminates all sources of error due to reference zener diode drift with time.

Unique Ohms Guard. The 5900 has a unique ohms guard which allows certain in-circuit ohms measurements to be made at full accuracy. The measurement of resistor networks (e.g., strain bridges) without the need to disassemble individual resistors or to calculate their values from a series of measurements is now possible. The ohms guard is particularly effective in preventing tribo-electric errors in systems applications where long input leads are utilized.

True Systems Compatibility.

Isolated Programming and Output. The standard digital output and optional remote programming in every 5900 are fully isolated with both double guarded toroids and an LED/photo transistor technique. This ensures full common mode rejection, no matter how the instrument is connected into a system.

Buffered Programming and Output. In addition to being fully isolated, the programming and output functions are fully buffered, which prevents the introduction of noise into the instrument via the input/output lines. Also, the meter is protected from damage from accidental grounding of the lines to earth.

Built-in System Timing. The BCD output and remote programming capability of the 5900 are further enhanced by built-in timeouts which allow for analog circuitry settling times. This prevents "first reading" errors. After a read command is given, an appropriate time delay is inserted before the DVM takes a measurement and issues a print command, thereby ensuring that the BCD output data have the full accuracy of the instrument.

100 Readings Per Second. With a 5900 more than 20 readings (complete full-scale step to 60% overrange) per second can be made on all measurements. A programmable super-fast mode of operation is also standard. When operating in this mode, the instrument provides four full digits of data, plus one digit of overrange and high-speed measuring capability – a speed of 100 readings per second.

GPIB Interface.

Microprocessor Controlled. With the Model 55 Microprocessing GPIB, the 5900 can be interfaced with other instrumentation and control devices utilizing the "IEEE bus." Full systems capability is provided with the 5900 having

oth "talker" and "listener" capability. The Model 55, itself, s completely self-contained in a 1 3/4 inch high, rack-nountable, piggyback package to the 5900. It is compliant vith the IEEE-STD-488-1975, "IEEE Standard Digital nterface for Programmable Instrumentation."

Jser Orientation.

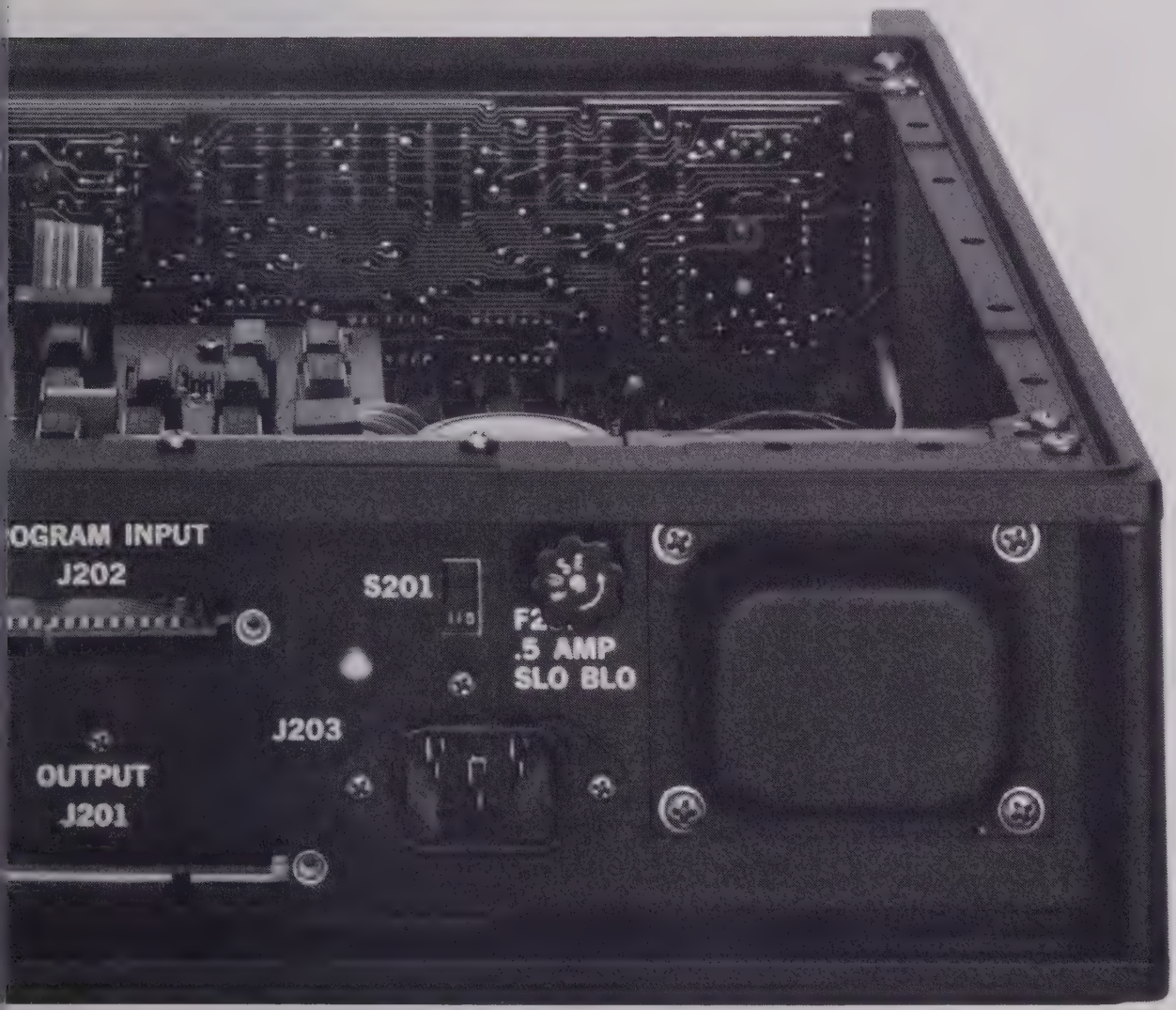
elf Check Diagnostics. The 5900's continuous self check iagnostics provides a warning on the front panel whenever: l) an illegal range/function combination has been selected o make a measurement, (2) a measurement function has een selected for which the 5900 is not equipped, or (3) he 5900 is operating in an overload condition. This informa-ion is also made available at the BCD or GPIB output to revent recording erroneous data.

ull Autoranging. The 5900 offers either full autoranging or nanual selection of any range in any function as a standard eature. Without touching a range control, the operator nay read DC from 1 μV to 1100 V, AC from 10 μV to 1000 V, nd resistance from 100 μohms to 160 megohms.

LED Readout. The 5900 is equipped with a highly reliable and long-life LED display that provides five full digits of readout and a sixth digit for 60% overranging. The use of LEDs eliminates the need for high voltage, which is necessary for operating other types of displays. In addition, a circuit in the 5900 eliminates all insignificant zeros in the readout. This helps prevent the operator from making erroneous readings, since only meaningful digits are displayed.

Reliable IC Design. The 5900 Digital Multimeter is equipped with IC sockets for accepting plug-in components. Should an integrated circuit malfunction at any time, this built-in feature allows correction by simply plugging in a replacement component. Furthermore, the 5900 uses standard, readily available 7400 Series TTL integrated circuits.

Maintainability. The Series 5900 instruments offer simplicity of design, which makes them much easier to maintain. An uncluttered circuitry layout permits easy instrument calibration and fast trouble-shooting. Instructions are printed on the inside cover of the instrument, which further facilitates calibration.



Dana Model 5900 Specifications

DC VOLTS
(Included in Basic Instrument)

Ranges:	±.100000V, ±1.00000V, ±10.0000V, ±100.000V, ±1000.00V
Resolution:	0.001% of range 1μV on 0.1V range
Overrange:	60% except 1000V range (1100V maximum input)
Maximum Input Voltage:	1100V DC or 1400V peak AC on all ranges.
Accuracy:	24 hours, 23°C ±1°C (no adjustments) 10V ±0.001% F.S. 1V-1000V ±0.001% R ±0.001% F.S. .1V ±0.002% R ±0.005% F.S. 90 days, 23°C ±5°C (After zeroing on 0.1V range) 10V ±0.001% R ±0.001% F.S. 1V-1000V ±0.002% R ±0.001% F.S. .1V ±0.003% R ±0.005% F.S. 1 year, 23°C ±5°C (After zeroing on 0.1V range) 10V ±0.003% R ±0.001% F.S. 1V-1000V ±0.004% R ±0.001% F.S. .1V ±0.005% R ±0.005% F.S.
Temperature Coefficient:	0°C-50°C 10V ±(1.5 ppm R + .5 ppm F.S.)/°C 1V-1000V ±(3 ppm R + 1 ppm F.S.)/°C 0.1V ±(4 ppm R + 5 ppm F.S.)/°C
Non-Linearity:	23°C ±5°C All ranges: less than or equal to .5 digit non-linearity to 160% of full scale.
Input Impedances:	0.1V-10V >10,000MΩ 100V-1000V >10MΩ
Input Bias Current:	10 pA at time of calibration (±100 pA for 30 days at 25°C)
Input Bias Current Temperature Coefficient:	±5 pA/°C
Normal Mode Rejection:	
Unfiltered	48 dB at every multiple of 60 Hz
Filtered	100 dB at 60 Hz
Common Mode Rejection:	
With 100Ω unbalance in either lead unfiltered	140 dB at DC, 120 dB at 61 Hz and below plus an additional 54 dB at harmonics of 60 Hz.
With 100Ω unbalanced in either lead, filtered	140 dB DC to 61 Hz 126 dB 61 Hz to 100 kHz
Settling Time:	
Unfiltered	Settles to within 0.01% in 5 msec with 10kΩ source, 10 mSec on 100V range.
Filtered	Settles to within 0.01% in 450 msec with 10kΩ source.

OHMS
(Option 52)

Ranges:	10.0000Ω, .100000kΩ, 1.00000kΩ, 10.0000kΩ, 100.000kΩ, 1000.00kΩ, 10.0000MΩ, 100.000MΩ.
Resolution:	0.001% of range 100μΩ on 10Ω range
Overrange:	60% on all ranges
Maximum Input Voltage:	±500V peak on all ranges
Measurement Scheme:	True 4-wire
Accuracy:	24 hours, 23°C ±1°C 10Ω ±0.003% R ±0.005% F.S. .1kΩ-1000kΩ ±0.002% R ±0.001% F.S. 10MΩ ±0.01% R ±0.001% F.S. 100MΩ ±0.02% R + 0.001% F.S. 90 days, 23°C ±5°C 10Ω ±0.005% R ±0.005% F.S. .1kΩ-1000kΩ ±0.003% R ±0.001% F.S. 10MΩ ±0.03% R ±0.001% F.S. 100MΩ ±0.03% R ±0.001% F.S.

OHMS continued

Temperature Coefficient:	0°C-50°C 10Ω ±(8 ppm R + 5 ppm F.S.)/°C .1kΩ, 1kΩ ±(7 ppm R + 1 ppm F.S.)/°C 10kΩ-1000kΩ ±(6 ppm R + 1 ppm F.S.)/°C 10MΩ ±(30 ppm R + 1 ppm F.S.)/°C 100MΩ ±(50 ppm R + 1 ppm F.S.)/°C
Open Circuit Voltage:	10Ω-1kΩ 2.5V maximum 10kΩ-100MΩ 22V maximum
Current Through Unknown:	10 — 10.101 mA 100Ω — 11.1111 mA 1kΩ — 1.11111 mA 10kΩ — 1 mA 100kΩ — 100 μA 1000kΩ — 10 μA 10MΩ — 1 μA 100MΩ — 100 nA
Normal Mode Rejection:	
Unfiltered	48 dB at every multiple of 60 Hz
Filtered	100 dB at 60 Hz
Common Mode Rejection:	
With 100Ω unbalance in either lead, unfiltered	140 dB at DC, 120 dB at 61 Hz plus an additional 54 dB at harmonics of 60 Hz.
With 100Ω unbalance in either lead, filtered	140 dB DC to 61 Hz 126 dB 61 Hz to 100 kHz
Settling Time: to rated accuracy	10Ω-10MΩ — 30 msec 100MΩ — 300 msec
Ohms Guard:	Use "Analog-Out" low on rear panel when in ohms.

RATIO
(included in Basic Intrument, 3-wire; Option 62, 4-wire)

3-Wire (Standard)	Independent ratio on all functions and ranges.
Readout:	$\frac{(10V)}{(Ref\ V)} \times \frac{(Input)}{(F.S.\ of\ range)} \times 10$
Reference Voltage Range:	+1V to +10.5V
Maximum Input Voltage:	Same as function.
Accuracy:	24 hours, 23°C ±1°C DC, AC – same as respective 24 hour, 23°C ±1°C spec. times $\frac{(10V)}{(Ref\ V)}$
Reference Input Impedance:	1000MΩ
Reference Settling Time:	10 mSec to 0.01% accuracy.
4-Wire (Option 62)	Independent ratio on all functions and ranges.
Readout:	$\frac{(10V)}{(Ref\ V)} \times \frac{(Input)}{(F.S.\ of\ range)} \times 10$
Reference Voltage Range:	+1V to +10.5V
Maximum Input Voltage:	Same as function.
Accuracy:	24 hours, 23°C ±1°C DC, AC – same as respective 24 hour, 23°C ±1°C spec. times $\frac{(10V)}{(Ref\ V)} \times 2$
Reference Input Impedance:	
Both leads with respect to — sig. input	1000MΩ ± min. + lead 10MΩ ±10% — lead
Reference Input to Sig. Common Voltage:	±15V max. (either input)
Reference Settling Time:	50 mSec to 0.01% of rated accuracy.

AC VOLTS
TRUE RMS (Option 32 AC Converter)

Ranges:	1.00000V, 10.0000V, 100.000V, 1000.00V rms
Resolution:	0.001% of range 10μV on 1V range
Overrange:	60%, (within max input voltage limit)
Maximum Input Voltage:	1000 V DC/rms or 1500 V peak, decreasing to 20 V rms at 1 MHz. 2×10^7 VHz maximum on any range.
Maximum Crest Factor: (Pulses at 1 kHz Repetition Rate)	7:1 at full scale $7 \times \sqrt{\frac{\text{F.S.}}{\text{V input}}}$ for other voltages
Accuracy:	90 days, 23°C ±5°C
AC Mode from .1% to 160% of full scale	20 Hz to 30 Hz (filtered) ±(.5% R + .04% F.S.) 30 Hz to 50 Hz (filtered) ±(.2% R + .04% F.S.) 50 Hz to 100 Hz (filtered) ±(.1% R + .04% F.S.) 100 Hz to 20 kHz (filtered) ±(.07% R + .04 F.S.) 200 Hz to 20 kHz (no filter) ±(.07% R + .04 F.S.) 20kHz to 50 kHz (both) ±(.1% R + .1% F.S.) 50 kHz to 100 kHz (both) ±(.4% R + .2% F.S.) 100 kHz to 300 kHz, 10, 100, 1000V range ±(3% R + .5% F.S.) 100 kHz to 300 kHz 1V range ±(5% R + 1% F.S.) 6 mos., 23°C ±5°C 20 Hz to 50 kHz Add ±(.01% R + .01% F.S.) 50 kHz to 100 kHz Add ±(.02% R + .02% F.S.) 100 kHz to 300 kHz Add ±(1% R + .1% F.S.)
AC + DC Mode	Add ±.02% F.S. to AC specification For inputs greater than 500V add .1% R
Temperature Coefficient:	0°C to 50°C AC Mode (to 20 kHz) ±(.004% R + .003% F.S.)/°C AC & DC Mode (to 20 kHz) ±(.004% R + .005% F.S.)/°C
Input Impedances: **AC Mode**	1 Megohm ±0.1% in series with 0.22μF shunted by less than 100 pF to common

Common Mode Rejection: **with 100 ohm unbalanced in either lead. DC to 60 Hz**	Range	CMR
	1V	120 dB
	10V	100 dB
	100V	80 dB
	1000V	60 dB

Settling Time:	(to within .1% of range)	Filter Out	Filter In
	0 to Full Scale Step	80 msec	350 msec
	Full Scale to 10% F.S. Step	100 msec	400 msec

AC VOLTS
(Option 33 AC Converter, Averaging)

Ranges:	1.00000V, 10.0000V, 100.000V, 1000.00V rms
Resolution:	0.001% of range 10μV on 1V range
Overrange:	60% except 1000V range (1000V rms maximum input)
Maximum Input Voltage:	1000V rms or 1400V peak, decreasing to 20V rms at 1 MHz. 2×10^7 V Hz maximum on any range.
Accuracy: **V_{in} < 500 V RMS**	24 hours, 23°C ±1°C 20 Hz to 30 Hz (filtered) ±0.02% R ±0.002% F.S. 30 Hz to 60 Hz (filtered) ±0.1% R ±0.002% F.S. 60 Hz to 100 Hz (filtered) ±0.05% R ±0.002% F.S. 100 Hz to 5 kHz (filtered) ±0.02% R ±0.002% F.S.

(All specifications are subject to change at manufacturer's discretion.)

AC VOLTS continued

Accuracy:	100 Hz to 300 Hz (no filter) ±0.1% R ±0.002% F.S. 300 Hz to 5 kHz (no filter) ±0.02% R ±0.002% F.S. 5 kHz to 100 kHz (both) ±0.04% R ±0.005% F.S. 100 kHz to 300 kHz (both) ±0.1% R ±0.01% F.S. 300 kHz to 1 MHz (both) ±0.5% R ±0.05% F.S. 90 days, 23°C ±5°C add ±0.01% R to 24 hour specification. 6 months, 23°C ±5°C add ±0.02% R to 24 hour specification.
V_{in} > 500V rms	f < 5 kHz Add ±0.02% R f ≧ 5 kHz Add ±0.08% R
Temperature Coefficient:	0°C-50°C 50 Hz to 20 kHz (filtered) ±(0.003% R + 0.0005% F.S.)/°C 20 kHz to 100 kHz (both) ±(0.005% R + 0.002% F.S.)/°C 100 kHz to 1 MHz (both) ±(0.01% R + 0.01% F.S.)/°C
Input Impedances:	1 MΩ ±0.1% in series with 0.22 μF shunted by less than 100pF to common.

Common Mode Rejection: **With 100Ω unbalance in either lead, DC to 60 Hz**		
	1V	120 dB
	10V	100 dB
	100V	80 dB
	1000V	60 dB

Settling Time:
Unfiltered Settles to within rated accuracy in 200 msec
Filtered Settles to within rated accuracy in 600 msec
(Zero to full scale or full scale to 10% of full scale)

GENERAL

Conversion Technique:	Delayed Dual Slope
Signal Integration Time: (60 Hz Standard)	16⅔ msec 1⅔ msec in Superfast
Reference Integration Time:	0-26⅔ msec, 0-2⅔ msec in Superfast
Polarity Selection:	Automatic
Ranging:	Autoranging is standard, upranges at 160% F.S. and downranges at 15% F.S.
Read Rate:	3⅓ rdg per sec to hold.
Common Mode Voltage:	1000V peak or D.C. Guard to case with logic common tied to case. 250V analog common to guard.
Display:	5 full decades plus overrange digit (LED .4 inches high) plus decimal point and function annunciator.
Overrange Indication:	Maximum reading is 160000 and "NO" annunciator is illuminated.
Filter:	4-pole active
Analog Signal Output:	Signal input scaled and buffered 0 to ±16V. DC voltage is available for driving a recorder or as an accurate voltage source.
Power Requirement:	100-240V (Selectable) 50-60 Hz Standard 400 Hz Optional 40 watts maximum
Weight:	16 lbs. (7.3 kg)
Dimensions:	3.5" x 14" x 16.75" (89 mm x 356 mm x 425 mm)
Temperature Range:	Operating 0°C-50°C Storage −40°C-70°C
Humidity, Operating:	<75%; 25°C-40°C <50%; 40°C-50°C
Fan:	None required.
Vibration, Operating:	0.025 double amplitude to 50 Hz for 15 minutes.
Full Scale (F.S.):	Defined as "100000" reading on any range.

DATA OUTPUT
(Included in the Basic Instrument)

Information:	All BCD outputs of display, 4-Bit Range code function flags, polarity flags, special flags, and logic supplies.
Logic Type:	Standard TTL levels, 8-4-2-1 BCD.
Input Commands:	Superfast Data Disable System Direct Command
Maximum Read Rate:	26 per sec to full scale, 120 per sec to full scale in Superfast, 60 Hz Operation.
Isolation:	Data output common may be floated up to 200V peak from power line common.

50 Hz OPERATION (Option 04)

For instruments modified for operation at 50 Hz line frequency, the specifications are the same as 60 Hz operation except as follows:

Signal Integration Time:	20 msec 2 msec in Superfast
Reference Integration Time:	0-32 msec 0-3.2 msec in Superfast
Normal Mode Rejection:	
Unfiltered	48 dB at every multiple of 50 Hz
Filtered	100 dB at 50 Hz

SUPERFAST

Ranges & Functions:	All ranges and functions
Command:	Must be commanded through rear printer connector (J201), or through programmer option (J202).
Display:	Four digit display with 60% overrange
Maximum Read Rate:	(60 Hz standard) 98 readings/sec. minimum at full overrange. 120 readings/sec. at full scale.
Accuracy:	Standard accuracy for range and function plus .03% of reading plus .03% of full scale.

REMOTE PROGRAMMING
(Option 42 Parallel BCD)

Input Information:	Provides isolated programming of all DMM functions and ranges.
Logic Type:	Standard TTL levels, 8-4-2-1 BCD.
Functions:	Function lines are programmed by a closure to ground (low TTL level).
Ranges:	Range lines are 8-4-2-1 coded positive true logic.
Command Modes:	Direct Command Timeout Command Superfast

(Model 55 GPIB)

Output Information:	Numeric data, polarity, function, and special flags
Data Output Format:	DC, AC, Ratio: same as front panel display with no leading zero suppression. Ohms: readout expressed as kohms
Input Information:	Functions, ranges, and filter
Command Modes:	Direct Command Timeout Command Superfast
Electrical Compatibility:	IEEE Std. 488-1975
Information Format:	7-bit ASCII code
Power Requirement:	20 Watts maximum
Line Voltage:	100/120/220/240V ±10% 48-440 Hz
Weight:	3.2 Kg (7 lbs.)
Dimensions:	44mm x 356mm x 425mm (1.75" x 14" x 16.75")
Equipment Provided:	Power cord, instruction manual and interconnection cables between the Model 55 and 5900.

HOW TO ORDER INSTRUMENTS AND ACCESSORIES:

To order the 5900 DMM, provide a complete model number, indicating both the basic instrument and all options and accessories that are to be included. The total cost is the sum of the individual items ordered.

Refer to Dana's Master Price List when ordering options and accessories separately.

Basic Instrument

Model 5900 Digital Voltmeter
(includes DC, 3-wire ratio, BCD output, analog output) $2,195

Options

04	50 Hz Operation (50 Hz noise rejection)	$ 30
71	230V Operation	N/C
—1	Parallel Rear Signal Input (Viking TKR7-101 connector)	$ 50
—1B	Parallel Rear Signal Input (Amphenol MS3102A14S-6S connector)	$ 50
—1S	Isolated Switchable Front/Rear Inputs (Viking TKR7-101 connector)	$220
—1SB	Isolated Switchable Front/Rear Inputs (Amphenol MS3102A14S-6S connector)	$220
12	Accessory card	$ 99
*32	True RMS AC Converter	$350
*33	Averaging AC Converter	$350
42	Remote Programming (BCD)	$475
*52	4-Wire Ohms Converter	$350
†55	Microprocessing GPIB	$825
57	GPIB (IEEE-488) System Interface (includes both Options 42 and 55)	$600
62	4-Wire Ratio	$200

*Requires Option 12 †Requires Option 42

Accessories

403402	Rack Mounting Flanges for 5900	$20/set
403644	10 Pin Extender Card	$ 30
403645	12 Pin Extender Card	$ 30
402190	Input Cable	$ 20
403921	Rack Mounting Flanges for 55	$ 20
406845	GPIB Cable (1 Meter)	$ 60
406844	GPIB Cable (2 Meter)	$ 65
406846	GPIB Cable (4 Meter)	$ 70

(All prices in U.S. funds and are subject to change without notice.)

DANA®

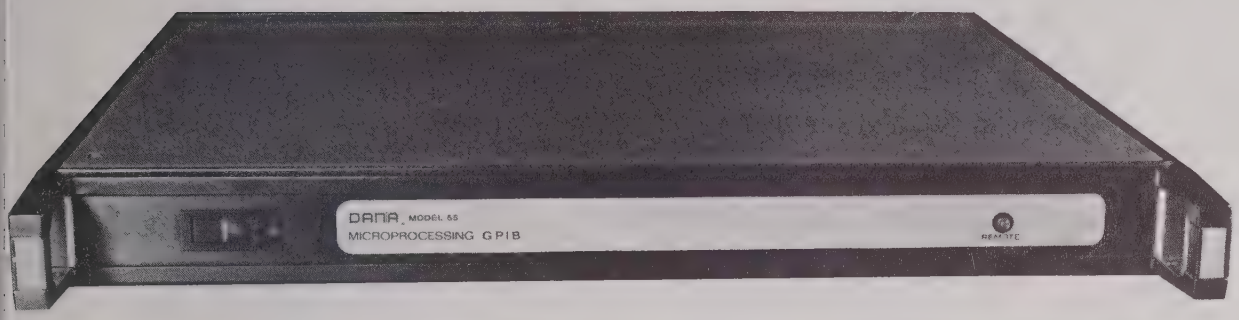
Dana Laboratories, Inc.
2401 Campus Drive, Irvine, CA 92715,
Telephone 714/833-1234, Teletype 910-595-1136, Telex 67-8341.

Products made in U.S.A

Available on GSA Contract No. GS-00S-27543

Printed in U.S.A., December 1976, 10M

Model 55 Microprocessing GPIB Interface



he Model 55 Microprocessing GPIB enables the ana Series 5000 and 5900 Digital Multimeters r the Series 6900 Precision Voltmeters to be terfaced with other instrumentation and con- ol devices utilizing the "standard interface bus" tructure. The Model 55 Microprocessing GPIB completely self-contained in a 1-3/4 inch high, rack mountable, piggyback package. It is compliant with IEEE Std. 488-1975, "IEEE Standard Digital Interface for Programmable Instrumentation". All connectors and cabling to connect the Model 55 with the 5000, 5900, or 6900 are provided as well as the standard connector to connect with the "bus".

SPECIFICATIONS

Output Information:	Numeric data, polarity, function, and special flags.
Data Output Format:	DC, AC, Ratio: same as front panel display with no leading zero suppression. Ohms: readout expressed as kohms.
Input Information:	Functions, ranges, and filter.
Command Modes:	Direct Command Timeout Command Superfast (except 5000)
Electrical Compatibility:	IEEE Std. 488-1975
Information Format:	7-bit ASCII code
Power Requirement:	20 Watts Maximum

Line Voltage:	100/120/220/240V ±10%, 48–440 Hz
Weight:	3.2 Kg (7 lb.)
Dimensions:	44mm x 356mm x 425mm (1.75" x 14" x 16.75")

PRICES

Model 55 Microprocessing GPIB	$825
plus Option 94 if ordered for the 5000	
plus Option 42 if ordered for the 5900	
plus Option 50 if ordered for the 6900	
Model 62 Rack Mounting Flanges . . .	$ 20

DANA®

Dana Laboratories, Inc., 2401 Campus Drive, Irvine, California 92715, U.S.A.
Telephone (714) 833-1234, Teletype 910-595-1136, Telex 678-341

roducts made in U.S.A.

Printed in U.S.A. 6-76

The Model 5000 Digital Voltmeter.

• 100% Overrange • True RMS AC Volts
• 4-Wire, 4-Quadrant DC/DC Ratio
• Large Led Display • Switchable Filter

DANA®

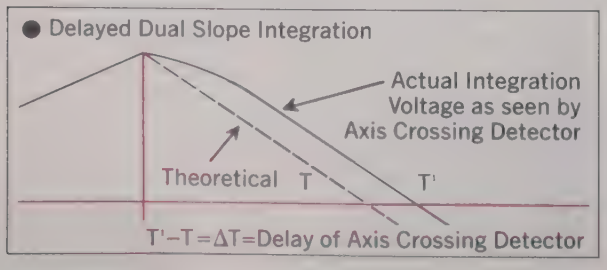
Others measure by us.

The Model 5000 Digital Voltmeter. We've reduced the price to the lowest in our history. But we haven't lowered our standards one bit.

Technical Innovations.

Our first decade of operation began with a major technical breakthrough in the data amplifier field. The years since have seen further significant technical contributions. In the Model 5000 Digital Voltmeter, we have implemented two important technical developments.

Delayed Dual Slope Integration. This is a technique used in the Model 5000 to reduce noise and increase linearity, making possible the 100% overrange, the reduction of bouncing digits, and the reduction of cost.



Briefly, the Model 5000 lowers noise by reducing the bandwidth of the axis crossing detector with a filter. This quiets the axis crossing detector, allowing lower integrator voltage swings to obtain the necessary dynamic range. This in turn permits the use of a low-cost IC amplifier in the design.

However, this filtering does delay the actual integration signal as seen by the detector by ΔT as shown above. The digitizer is preset with sufficient digits to compensate for this delay. This compensation also improves linearity because the axis crossing detector has more time to settle to final filter delay.

Internal Autozero Without Kickback. The diagram opposite shows schematically sources of offset voltage in a digital voltmeter. The 5000 uses an FET switching scheme in which Phase One grounds the digitizer input and puts the input offset voltage on C-Hold, a storage capacitor.

Phase Two, switches open, simply takes the measurement with C-Hold acting as an offset compensating battery. The isolator with patented input for low drift and high stability eliminates kick-back current from the autozero.

Low Price, High Standards.

The Model 5000 is the lowest-priced five-digit voltmeter Dana has ever produced. Yet the instrument reflects a high standard of design and performance. It was built by men responsible for voltmeters selling for many times the price of the 5000, and it benefits from their standards of excellence.

Reliability.

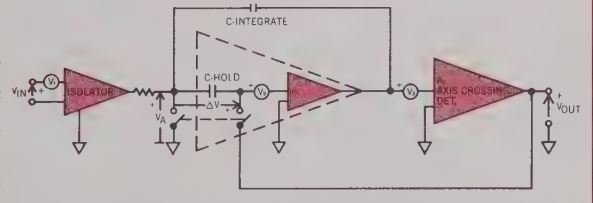
To ensure the utmost in reliability, Dana has used silicon solid state circuitry exclusively in the 5000.

All integrated circuits are tested prior to installation, and every voltmeter shipped from the factory is exposed to a 72-hour run-in at 50°C, a 2.5 G vibration test, and a 48-hour run-in at elevated temperature. These extensive quality control procedures isolate and help ensure the correction of infant component failures before the instrument reaches the customer.

Serviceability and Maintainability.

In a few minutes, the entire instrument can be disassembled and each circuit board removed for easy servicing. Calibration has been greatly facilitated by printing an abbreviated procedure on the instrument.

● Internal Autozero without Kickback



V_1, V_2, and V_3 Represent Major Offset Voltage Sources.
V_1=Manually Adjustable, Extremely Low Drift and Ultra Stable Due to Dana's Patented Input Circuitry.
$V_2 + V_3$=Auto Zero
Switch Closed:
V out=$\triangle V=V_2 + V_3$
Switch Open:
$\triangle V=V_2 + V_3$
$V_A=(V_2 + V_3) - \triangle V=0$

Features of the Basic DC Instrument.

5 DC Ranges—1 μV Resolution. Five standard DC ranges offer measurement capability from 1 μV through 1000V. In addition, this DC capability is provided in one mode of operation, and is completely autoranging.

Complete Autoranging. The 5000 offers autoranging in all functions (DC, AC, Ohms, and DC/DC Ratio), thus eliminating the need to select ranges manually. Kilohms through megohms ranging is completely automatic. Manual range switching is also standard.

Internal Autozero Without Kickback Current. A combination of Dana's patented Low Drift Isolator and internal closed loop autozeroing circuitry provides the unique and sensible capabilities of a highly stable electrical zero, with no kick-back current. This absence of kick-back current to the source permits the instrument to measure capacitive sources such as filter outputs.

10^{10} Ohm Input Resistance. Accuracy is further enhanced by an electrometer type input resistance on lower ranges, which permits measurement of megohm sources with less than 0.01% loading error. This high input impedance, which does not change during any part of the reading cycle, enables the 5000 to maintain high accuracy, regardless of source resistance.

100% Overrange. The 5000 provides 100% overranging on all ranges not limited by overload tolerances. It is especially useful when high resolution is required of such common voltages as ±15V, ±18V, and ±20V.

Large LED Display with Leading Zero Blanking. Reading is made much easier by an oversized LED display. Also, all but one non-significant zero left of the decimal point is blanked to reduce confusion. The display is a plug-in board which may be easily removed for convenient servicing.

Function Annunciators. An annunciator system is incorporated in the display, which indicates the function selected (AC, Kilohm, Ratio), filter and overload. The function annunciators are blanked for those options which are not installed.

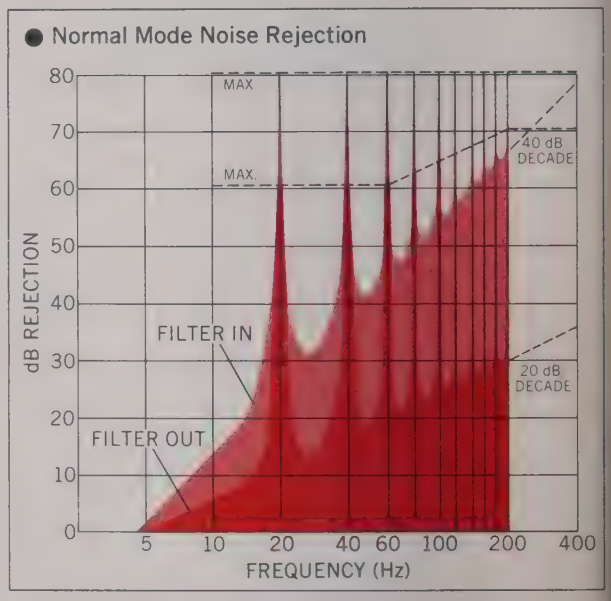
Switchable Filter—30 mSec Response Time. The 5000 uses the stable, reliable delayed dual slope integrating technique, which provides inherent noise rejection at multiples of 20 Hz (54 dB maximum at line frequency-filter out). A front panel selectable broadband filter is incorporated as part of the standard instrument, providing additional noise rejection over the complete band. DC settling time (filter out) is only 30 mSec. More detail is illustrated in the normal mode rejection curves.

1000 Volt Overload Protection in All DC and AC Ranges. 1000 volts DC and 1000 V RMS can be applied to all DC and AC ranges without damage. On Ratio, the reference input will withstand 300 V DC. These limits are designed to protect the machine under all reasonable—and most unreasonable—measurement situations.

Familiar 7400 Series Logic. Ease of service, low cost, backup, highest reliability and quick circuit familiarity are all facilitated by the use of 7400 Series TTL and a standard, commercially available MOS logic chip.

High Resolution Calibration. All critical calibration adjustments are quality multi-turn potentiometers for maximum resolution and stability. All adjustments are convenient and are protected from being accidentally disturbed.

Plug-In Accessories. Accessory functions, such as AC, Ohms, and Ratio, are plug-in modules and may be installed in the field. In instruments with systems capability, the systems interface may also be installed in the field.



Optional Accessories.

AC Volts:

True RMS AC. The Model 44 True RMS AC Converter provides 0.1% typical accuracy over crest factors ranging from 7 to 22. The resolution is 10μV and settling time is less than 600 milliseconds. The Converter operates in either AC or AC + DC mode.

Broadband Averaging AC—30 Hz to 250 kHz. Dana's plug-in Model 34 AC Converter covers both low-frequency and high-frequency measurement requirements in four ranges from 1V through 1000V with 10μV resolution. Typical accuracy is 0.1% with 600 milliseconds settling time.

Ohms:

Six Kilohm Ranges—1 Milliohm Resolution. A plug-in Model 54 Ohms Converter is available for expanding instrument capability to cover six ranges of ohms, from 100 ohms to 10 megohms (with 100% overranging, from 200 ohms to 20 megohms). Its 1 milliohm resolution greatly expands the applicability to low ohms measurements.

4-Wire Ratiometric® Ohms Measurements. Four-wire ohms configuration allows small resistance values to be precisely measured. This configuration eliminates most errors caused by lead resistance. The Ratiometric® scheme eliminates reading errors caused by reference drift.

Low Test Voltages and Currents. The maximum test voltage applied across the unknown resistance is 5 Volts DC for a full-scale 10 megohm reading. Maximum test current is 1 milliampere.

250 Volts DC or RMS AC Protection in All Ranges.

DC/DC Ratio:

4-Wire—4-Quadrant—Autopolarity. Dana's 4-wire, 4-quadrant polarity scheme (Option 64) is unique in the industry. It permits the measurement of ratios between bipolar signals and bipolar references with autoranging and autopolarity. Five ranges of DC/DC ratio are available (Option 64), with isolation between signal and reference commons. This virtually eliminates ground loop errors and greatly increases applicability as a ratiometer. Highly accurate ratio measurements, such as mV to volt ratios common to strain gauge work, transfer functions, voltage dividers and DC amplifier gains, are greatly facilitated.

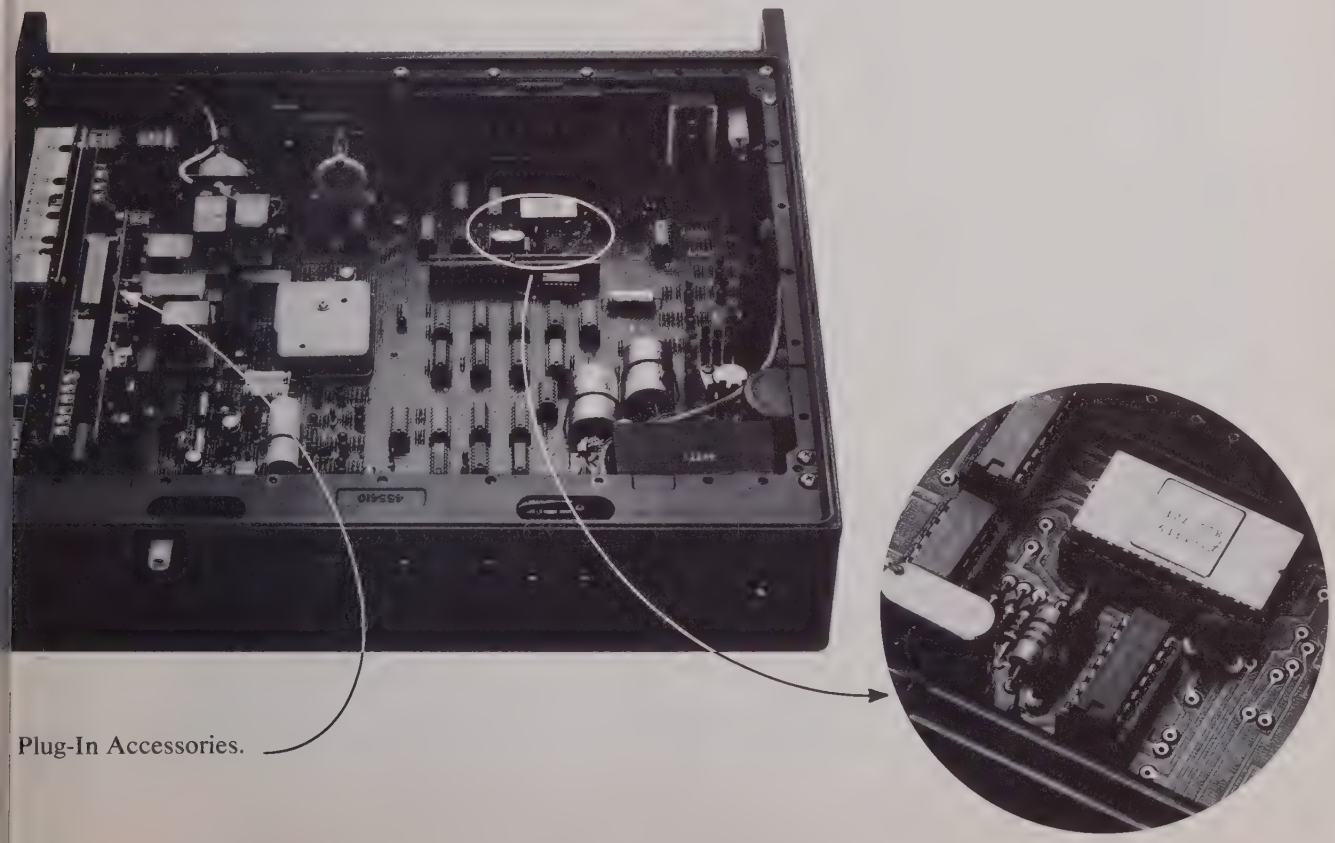
100-Volt Reference. A special option. If necessary, the 5000 can be modified to accept an external 100-volt reference, in addition to the 10-volt reference.

300-Volt DC Reference Protection. The reference input circuit will withstand 300 VDC or RMS AC overload. The input signal is protected to 1000 VDC.

AC/DC—Ohms/DC Ratio: This capability is available with the system programming option.

General:

Parallel Front/Rear Input. This option permits use in a wide variety of applications in which input requirements might vary. Rear input is especially useful in applications where the instrument is rack-mounted.



Plug-In Accessories.

Systems Interface:

Data Output and Programming are available as Option 94.

Isolated, Buffered and Stored TTL BCD Output. The 5000 with option 94 can be easily interfaced to digital recording equipment, computers, or other devices operating with digital inputs. The TTL isolated BCD output provides full isolation from signal sources and recording devices. TTL compatible outputs of range, functions, and polarity are provided, using solid-state techniques. Reed relays have been eliminated from the isolation circuitry, greatly increasing speed and reliability. In addition, the outputs are buffered from the digitizer to prevent system malfunctions from doing major damage to the instrument. Also, memory has been provided to hold the previous reading while a new reading is being made.

Isolated and Buffered Programming with Memory. All ranges, functions, and filter positions are completely programmable in the 5000 with option 94. All command input lines are isolated, and buffered through solid state optical couplers, permitting interfacing with both grounded and ungrounded equipment, while still maintaining high common mode noise rejection. Memory is provided so previous commands may be stored until the program is updated.

Accurate Built-In System Time-Outs. The 5000/94 has special circuitry included which provides print command delays (automatic time-outs). The user may select a direct command, in which case a print command is issued immediately. A delayed command is issued with an appropriate time-out, according to the instrument's function, introduced before the digitizing cycle.

Range Programming and Data Output Codes

Range	Range R_1	Range R_2	Range R_4	Range R_8
Auto Range	0	0	0	0
.1 KΩ, .1V	1	1	0	0
1 KΩ, 1V	0	0	1	0
10 KΩ, 10V	1	0	1	0
100 KΩ, 100V	0	1	1	0
1 MΩ, 1000V	1	1	1	0
10 MΩ	0	0	0	1

System Applications – Interface Data.

Output Levels. T^2 logic levels (approximately 2.4V true; .4V false). Higher voltage outputs available on special request.

Read Commands. Ground to read.

BCD Data. 1-2-4-8 positive true (negative true available on special request).

Data Transfer Time. 5 milliseconds.

Programming Set-Up Time. 5 milliseconds.

Print Commands. 5 milliseconds pulse at end of reading. Modes of operation and timing are as follows:

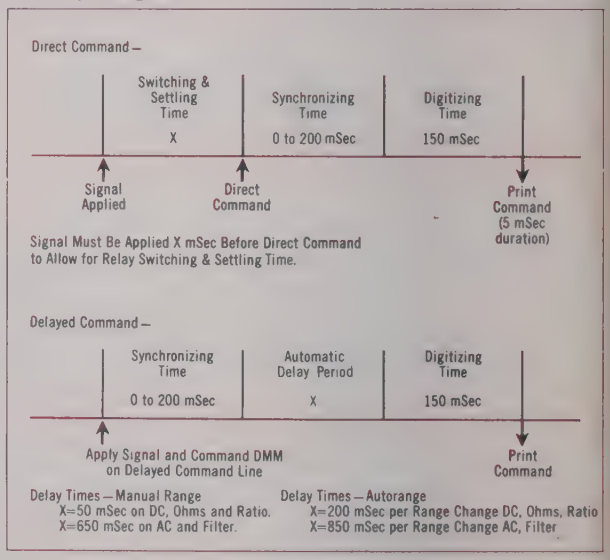
Periodic – Print command occurs every 200 milliseconds; print command is skipped during autoranging.

Hold – One print command per read command except if autorange occurs, then print command is skipped and range is stepped up or down. Print command timing for the two read commands are:

A. Direct Command – One print command after each reading (shown in timing diagram).

B. Delayed Command – One print command after each reading (shown in timing diagram).

Timing Diagram


Direct Command –
Switching & Settling Time
X
Synchronizing Time
0 to 200 mSec
Digitizing Time
150 mSec
Signal Applied
Direct Command
Print Command (5 mSec duration)
Signal Must Be Applied X mSec Before Direct Command to Allow for Relay Switching & Settling Time.
Delayed Command –
Synchronizing Time
0 to 200 mSec
Automatic Delay Period
X
Digitizing Time
150 mSec
Apply Signal and Command DMM on Delayed Command Line
Print Command
Delay Times – Manual Range
X=50 mSec on DC, Ohms and Ratio.
X=650 mSec on AC and Filter.
Delay Times – Autorange
X=200 mSec per Range Change DC, Ohms, Ratio
X=850 mSec per Range Change AC, Filter

Model 5000 rear panel.

PROGRAMMING CONNECTOR J-208

Top Side	Bottom Side
1-B	1-A
2-B	2-A
3-B	3-A
4-B	4-A
5-B	5-A
6-B	6-A
7-B $\overline{\text{Filter}}$	7-A
8-B $\overline{\text{Ratio}}$	8-A $\overline{\text{AC}}$
9-B Data Inhibit	9-A KΩ
10-B $\overline{\text{Delayed Command}}$	10-A $\overline{\text{Hold}}$
11-B Range R_8 (Range Programming)	11-A
12-B Range R_1 (Range Programming)	12-A
13-B Range R_2 (Range Programming)	13-A + 5 Volts
14-B Range R_4 (Range Programming)	14-A Digital Common
15-B $\overline{\text{Program Storage}}$	15-A Direct Command

Connector—Viking—2V 15/1JN5 Dana P/N 403714

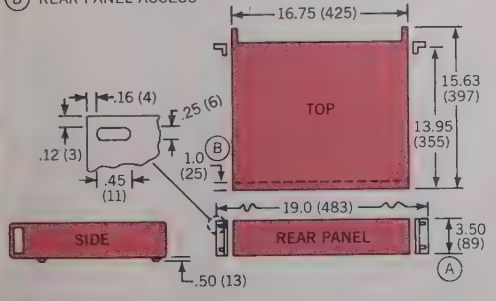
DATA OUTPUT CONNECTOR J-209

Top Side	Bottom Side
1-B Digital Common	1-A AC
2-B Kohms	2-A Ratio
3-B +5 Volts	3-A
4-B	4-A
5-B Filter	5-A
6-B 10 K_1 (10 K's Decade)	6-A
7-B 10 K_4 (10 K's Decade)	7-A $\overline{\text{Data Inhibit}}$
8-B 100 K_1 (10 K's Decade)	8-A $\overline{\text{Direct Command}}$
9-B 10 K_8 (10 K's Decade)	9-A – Polarity (Polarity Lines)
10-B 10 K_2 (10 K's Decade)	10-A + Polarity (Polarity Lines)
11-B	11-A Print
12-B 1K_4 (1 K's Decade)	12-A OL(100 K_2)
13-B 1K_1 (1 K's Decade)	13-A External Supply Voltage
14-B 1K_8 (1 K's Decade)	14-A R_8 (Range Lines)
15-B 1K_2 (1 K's Decade)	15-A R_1 (Range Lines)
16-B 100$_4$ (100's Decade)	16-A R_4 (Range Lines)
17-B 100$_1$ (100's Decade)	17-A R_2 (Range Lines)
18-B 100$_8$ (100's Decade)	18-A 1_2 (1's Decade)
19-B 100$_2$ (100's Decade)	19-A 1_8 (1's Decade)
20-B 10$_4$ (10's Decade)	20-A 1_4 (1's Decade)
21-B 10$_1$ (10's Decade)	21-A 1_1 (1's Decade)
22-B 10$_8$ (10's Decade)	22-A 10$_2$ (10's Decade)

Connector—Viking—2VH22/1JNS Dana P/N 403715

DIMENSIONS

DIMENSIONS IN INCHES (mm)
(A) E. I. A. RACK HEIGHT
FOR CABINET HEIGHT ADD FEET HEIGHT
(B) REAR PANEL ACCESS



Dana Series 5000 Specifications

DC VOLTAGE

Full Range Display:	±.100000, ±1.00000, ±10.0000, ±100.000, ±1000.00
Overrange:	100% on all ranges, ±1000 volts maximum input
Resolution:	1 microvolt
Accuracy:	24 hours, 23°C, ±1°C 100 mV range ±(0.005% of reading +0.005% of range) 1V-1000V range ±(0.005% of reading +0.001% of range) 6 months, 23°C, ±5°C 100 mV range ±(0.01% of reading +0.005% of range) 1V-1000V range ±(0.01% of reading +0.002% of range)
Temperature Coefficient:	0°C to 50°C 100 mV range ±(0.002% of reading +0.002% of range)°C 1V-1000V range ±(0.001% of reading +0.0003% of range)°C
Input Resistance:	100 mV range 1,000 megohms 1 V range 10,000 megohms minimum 10, 100 and 1000V ranges 10 megohms
Normal Mode Noise Rejection:	Filter in At or near line frequency 80 dB (10,000 to 1) Filter out At or near line frequency 54 dB (500 to 1)
Common Mode Noise Rejection:	Up to 100 Ω in either lead: DC and at line frequency 140 dB minimum
Settling Time to 0.01% of Full Scale Step Input:	Filter in 600 mSec maximum Filter out 30 mSec maximum

DC/DC 4-WIRE RATIO—4-QUADRANT
(With addition of Option 64)

Full Range Display:	±.100000:1, ±1.00000:1, ±10.0000:1, ±100.000:1, and ±1000.00:1 (Readout is Ratio x 10)
Overrange:	100% on all ranges, ±1000 volts maximum input
Accuracy:	6 months, 23°C, +5°C .010000:1 range ±[0.02% R +0.005% (10V/ref.) F.S.] .100000:1 to 100.000:1 ±[0.01% R +0.002% (10V/ref.) F.S.]
Voltage Range:	Input Sig (Numerator) 0 to ±1000V; Reference Sig (Denominator) ±2 to ±11V; 300 volts DC or RMS AC overload protection
Input Resistance:	.01:1 range 1,000 megohms: 1 megohm .1:1 range 10,000 megohms: 1 megohm 1:1 range 10 megohms: 1 megohm 10:1 and 100:1 ranges 10 megohms: 1 megohm
Normal Mode Noise Rejection, Common Mode Noise Rejection, and Settling Time:	Same as DC specifications

WIDEBAND AC VOLTAGE
(With addition of Model 34 AC Converter

Full Range Display:	1.00000, 10.0000, 100.000, 1000.00 V RMS
Overrange:	100% on all ranges; Maximum Voltage Rating: 1000 volts to 10 kHz, decreasing linearly to 100V RMS at 100 kHz. Maximum input voltage x frequency should be less than 2×10^7 Volt-Hz.
Resolution:	10 microvolts

WIDEBAND AC VOLTAGE cont'd

WIDEBAND AC VOLTAGE cont'd

Accuracy:	6 months, 23°C, ±5°C 30 Hz to 50 Hz ±(0.20% of reading +0.02% of range) 50 Hz to 30 kHz ±(0.10% of reading +0.02% of range) 30 kHz to 100 kHz ±(0.15% of reading +0.02% of range) 100 kHz to 250 kHz–1, 10, 100 ranges ±(1% of reading +0.10% of range)
Input Resistance:	1 megohm
Shunt Capacitance:	100 pF front, 200 pF front/rear
Common Mode Noise Rejection:	Up to 100 ohms in either lead At line frequency 80 dB
Settling Time to 0.1% of Full Scale Step Input:	600 mSec maximum

RESISTANCE (4-WIRE OHMS)
(With addition of Model 54 Ohms Converter)

Full Range Display:	.100000, 1.00000, 10.0000, 100.000, 1000.00, and 10000.0 kilohms	
Overrange:	100% on all ranges Fault Voltage: All Ranges: 250V	
Resolution:	1 milliohm	
Accuracy:	6 months, 23°C, ±5°C .1 kilohm range ±(0.02% of reading +0.005% of range) 1, 10, 100 kilohm ranges ±(0.01% of reading +0.002% of range) 1000 kilohm range ±(0.02% of reading +0.002% of range) 10,000 kilohm range ±(0.03% of reading +0.002% of range)	
Settling Time to 0.01% of Full Scale Step Input:	Filter in Filter out	600 mSec 50 mSec
Current Through Unknown:	Kilohm Range .1 1 10 100 1000 10,000	Current 1.02 milliampere 1.25 milliampere 125 microamperes 50 microamperes 5 microamperes 0.5 microampere

GENERAL

Ranging:	Automatic or manual
Digitizing Technique:	Dual Slope Integrator
Integration Time:	50 mSec
Digitizing Time:	200 mSec maximum
Maximum Common Mode Voltage:	500 volts peak
Maximum Power Requirements:	Optional: 100, 115, 120, 220, 230, 240 V RMS ±10%; 50 to 400 Hz, 40 watts
Operating Temperature:	0°C to 50°C
Warm Up:	2 hours to full stability.
Dimensions:	17x3½x14 inches or 43.2x8.9x35.6 cm.
Weight (Approx.):	17 pounds net, 20 pounds shipping
Guarantee:	12 months, faulty workmanship or component failure

(All specifications are subject to change at manufacturer's discretion.)

DANA
Dana Laboratories, Inc.,
2401 Campus Drive
Irvine, Calif. 92664, U.S.A., Telephone (714) 833-1234
Teletype 910-595-1136, Telex 678-341

Dana's Representative in Your Area:

TRUE RMS AC VOLTS
(With addition of Model 44 True RMS Converter)

Ranges:	1.00000 V, 10.0000 V, 100.000 V, 1000.00 V RMS
Resolution:	0.001% of range 10μV on 1 V range
Overrange:	100% (within max.input voltage limit)
Maximum Input Voltage:	1000 V DC/RMS or 1500 V peak, decreasing to 20 V RMS at 1 MHz. 2×10^7 VHz maximum on any range.
Maximum Crest Factor: (Pulses at 1 kHz Repetition Rate)	7:1 at full scale 22:1 at 10% full scale
Accuracy:	90 days, 23°C±5°C AC Mode .1% FS ≤ V_{in} ≤ 200% FS 10 Hz-20 Hz ± (2%R + .04%FS) 20 Hz-30 Hz ± (.6%R + .04%FS) 30 Hz-50 Hz ± (.3%R + .04%FS) 50 Hz-20 kHz ± (.1%R + .04%FS) 20 kHz-50 kHz ± (.1%R + .1%FS) 50 kHz-100 kHz ± (.4%R + .2%FS) 100 kHz-300 kHz, 10, 100, 1000V range ± (3%R + .5%FS) 100 kHz-300 kHz, 1V range ± (5%R + 1%FS) 300 kHz-1 MHz Add {10f (MHz)%R + .5%FS} to 300 kHz spec AC & DC Mode add .02%FS to AC specification. For inputs greater than 500 V multiply %R spec by $(1 + \frac{V_{in}}{2000})$ 1 Hz operation available on special request.
Temperature Coefficient:	0°C to 50°C AC Mode (to 20 kHz) ± (.005%R + .003%FS)/°C AC & DC Mode (to 20 kHz) ± (.005%R + .005%RS)/°C
Input Impedances: AC Mode	1 Megohm ± 0.1% in series with 0.22 μF shunted by less than 100 pF to common
Common Mode Rejection: with 100 ohm unbalance in either lead. DC to 60 Hz	80 dB
Settling Time:	To within .1% of range 600 mSec max.

HOW TO ORDER INSTRUMENTS AND ACCESSORIES.

To order the 5000 Digital Voltmeter, provide a complete model number, indicating both the basic instrument and all options and accessories that are to be included. The total cost is the sum of the individual items ordered.

Refer to Dana's Master Price List when ordering options and accessories separately.

Basic Instrument

Model 5000 Digital Voltmeter.....$995

Optional Functions and Programming

Model 34 Averaging AC Converter	300
Model 44 True RMS AC Converter	375
Model 54 4-Wire Ohms	245
Model 64 4-Wire 4-Quadrant Ratio	200
Model 94 Remote Programming and Data Output	550
Rear Input – 1	50

Miscellaneous Accessories

Input Cable, Part Number 402190	$ 20
Rack Mounting Flanges, Part Number 403402	20
Extender Card, Kit, Part Number 403701	50
Current Shunts, Model Number 651	125

(All prices in U.S. Funds and are subject to change without notice.)

Available on GSA Contract No. GS-OOS-27543

The 4800 Digital Multimeter.

- 1 μV resolution on the 10mV range—one of six DC voltage ranges
- 10 μV AC resolution on either the RMS Distortion Insensitive or True RMS AC Converter
- 100 μohm resolution on the one ohm range—one of nine resistance measuring ranges
- Standard analog output for driving stripchart recorders
- Isolated BCD output standard
- mV/DC, DC/DC, AC/DC ratio capability standard

DANA®

Others measure by us.

4800 Digital Voltmeter

Dana introduces the 4800 Digital Voltmeter... a premium performance four-digit instrument which couples both the high accuracy and versatility required in laboratory applications with the speed and ease of interface required in systems applications.

ACCURACY

0.01% DC Accuracy

The basic 4800 maintains ± (0.01% of reading + 0.01% of full scale) accuracy on all five of its standard ranges for 24 hours, and ± (0.01% of reading + 0.01% of full scale) for 90 days and over a 10°C temperature span.

100% Overrange

The 4800 provides 100% overrange capability in all functions and on all ranges. This means that many measurements can be made with 5-digit resolution (i.e. 4800 reads 19.999 where other 4-digits read 019.99).

1 μV Resolution in 5 ms

The basic 4800 includes 5 DC ranges (0.1V, 1V, 10V, 100V and 1000V) which provide a maximum resolution of 10 μV. With the addition of the optional preamplifier, 1 μV resolution is achieved on the 10 mV range. Furthermore, the settling time of the preamplifier is only 5 ms.

Full Autoranging

Your choice of full autoranging or manual selection of any range in any function is a standard feature in the Series 4800. You have the capability to read DC from 1 μV to 1000V, AC from 10 μV to 1000V rms, and resistance from 100 μ ohms to 200 megohms without touching a range control.

Speed Plus 100 dB Noise Rejection

The 4800 combines both a fast settling multipole active filter with dual slope integration—this provides the best selection of speed and noise rejection. With the filter "out," the 4800 provides both 48 dB of line frequency noise rejection, and a worst case speed of 18 readings/second on all 5 DC ranges and both mV preamplifier ranges. With the filter "in" the noise rejection is increased to 100 dB, while the reading rate is maintained at 3-1/3.

STANDARD FEATURES

Full Ratio Capability

Easily accessible terminals are mounted on the rear panel of the 4800 to receive an external dc reference voltage for making real time dc/dc, ac/dc, mV/dc and Ω/dc, ratio measurements. This standard capability permits measurement of transfer functions such as voltage dividers, ac and dc amplifier gains, etc., with accuracy independent of the stability of the excitation voltage.

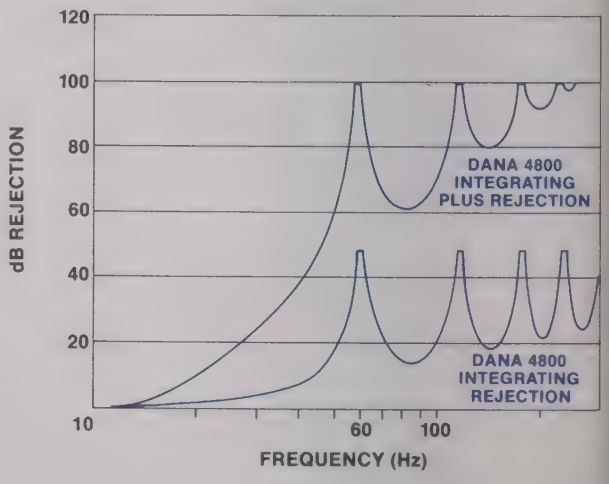
Analog Output

The 4800 features an analog output that is a 0 to 20 Volt DC analog level proportional to the parameter being measured. This output provides a full-scale analog equivalent of all input signals on any ac, dc, mV or ohm range and is extremely useful in recording drifts in power supplies, resistors, etc., on strip chart and X-Y recorders.

Isolated BCD Output

An all solid-state isolated BCD output is standard on every 4800. It provides TTL compatible output of reading, function, range, filter, polarity and a command to print. A line is also provided which will command the DVM to initiate a reading.

Noise Rejection Performance Curve



AC VOLTS

Most voltmeters read the DC equivalent of the average value of an AC signal by rectifying and filtering it. These types of average responding AC converters are calibrated to make accurate measurements on pure sine waves only. Unfortunately, "clean" AC signals may have up to 5% total harmonic distortion. A sine wave with as little as 3% total harmonic distortion (cannot be seen on an oscilloscope) could cause a 4-digit DVM equipped with an average responding converter to display a reading with over 100 digits of error. Consequently, no matter how an average responding AC converter is specified, its accuracy is generally limited to 1% in practical situations.

RMS DISTORTION INSENSITIVE

Dana's Model 21 Distortion Insensitive AC Converter has overcome this problem; it is capable of measuring sine waves quickly and accurately. In addition, it can measure the RMS value of sine waves with up to 5% total harmonic distortion as well as other waveforms, such as square waves, triangular waves, etc. with little or no degradation of accuracy.

0.03% AC Accuracy

The Model 21 maintains an accuracy over a frequency range of 50 to 20 kHz of ± (0.03% of reading + 0.03% of full scale) for 90 days, (25°C±5°C).

10 μV Resolution

The Model 21 Distortion Insensitive AC Converter has 5 full ranges plus 100% overrange. These five ranges, (0.1V, 1V, 10V, 100V and 1000V), provide resolution to 10 μV.

1 Megahertz Bandwidth

The 4800 equipped with the Model 21 can make accurate AC measurements from 30 Hz to 1 MHz.

350 ms Settling Time

The Model 21 provides the fastest, most accurate, 4-digit measurement of AC available. The fastest thermal type RMS converter requires a minimum of 1 second to settle; the 4800 can make three full measurements in this same time.

WAVEFORM	DISTORTION INSENSITIVE AC		AVERAGE RESPONDING AC	
	READING	ERROR	READING	ERROR
Pure Sine Wave	1.0000	0.00%	1.0000	0.00%
Sine Wave with 3% Harmonic Distortion	1.0003	0.03%	0.9900	1.00%
Triangle Wave	1.0001	0.01%	0.9620	3.80%
Gaussian Noise	0.9700	3.00%	0.8862	11.38%

TRUE RMS

The Dana Model 31 True RMS AC Converter provides a DC output voltage proportional to the Root Mean Square (RMS) value of the input signal. Thus, signals with high harmonic content such as noise and other complex waveforms can be measured easily and accurately. The use of log transistors, instead of a thermopile, results in fast settling times and wide dynamic range.

10 μV Resolution

The Model 31 True RMS AC converter has 5 full ranges of measurement capability plus 100% overrange. The resulting 10 μV resolution on the .1V range is the same resolution that is provided on 5-1/2 digit voltmeters with only 4 ranges.

7:1 to 22:1 Crest Factors

For measurements at full scale, the Model 31 can handle input signals with crest factors up to 7:1. For measurements taken at 10% of full scale, the Model 31's wide dynamic range allows accurate measurements of input signals with up to 22:1 crest factors.

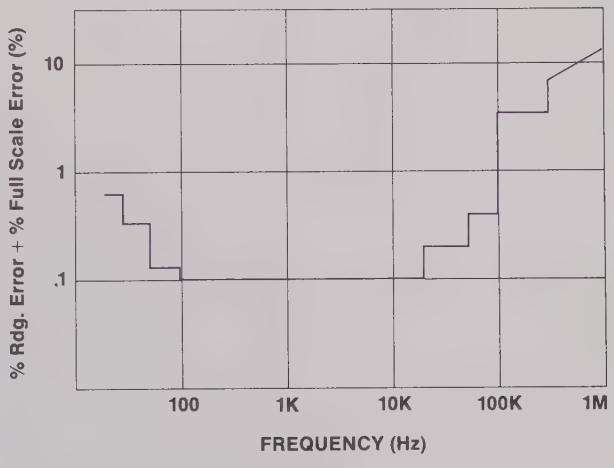
Extended Bandwidth

Accurate measurements from 20Hz to 300KHz and out to 1MHz can be made with the Model 31.

AC or AC & DC

Internal switching on the Model 31 provides you with the option of measuring the RMS value of only the AC component; or, both the AC and DC components of the incoming waveform.

Model 31 True RMS Accuracies



FOUR WIRE OHMS

True 4-Wire Sensing

The 4800 equipped with the Model 50 combination ohms/millivolt preamplifier provides true 4-wire sensing. Separate current and voltage leads are available to provide the ultimate in ohms accuracy by eliminating errors caused by input lead resistance. This feature becomes particularly significant in systems applications where leads of various lengths are commonly used.

0.01% Ohms Accuracy

The Model 50 maintains an accuracy of ±(0.01% of reading +0.01% of full scale) for 90 days and over a 10°C temperature span.

9 Ohms Ranges

The Model 50 has 9 full ohm ranges plus 100% overrange. These 9 ranges (1, 10 and 100 ohms; 1K, 10K and 100K ohms; 1M, 10M and 100M ohms), provide resolution from 100 microhms on the 1 ohm range to 10K ohms on the 100M ohm range.

Full Autoranging

The 4800 will autorange over all 9 ranges without the need for the user to touch the instrument. This capability to range from 100 μ ohms to 200M ohms is not available in any other 4-digit DVM.

Unique Ohms Guard

The 4800 equipped for measuring ohms has a unique ohms guard which allows certain in-circuit ohms measurements to be made at full accuracy. The measurement of resistor networks (ex: strain, gage bridges) without the need to disassemble individual resistors or to calculate their values from a series of measurements is now possible. It is particularly effective in preventing errors due to leakage resistance when measuring high value resistors.

Exclusive Ratiometric Ohms

Dana's ratiometric ohms converter maintains its high accuracy by measuring ohms using a ratio technique. This eliminates all sources of error due to the reference zener diode used to measure the voltage across the unknown and the reference zener diode used to generate the current through the unknown.

20 ms Settling Time

Dana's 4-wire ohms converter, besides being accurate is extremely fast; it settles to full accuracy in 20 ms on its 1 ohm full scale through 10M ohm full scale ranges. Furthermore, the 4800's dual slope integrator provides 48 dB of line frequency noise rejection at this speed. Thus megohm values are easily measured without the need for a filter. This further ensures that accuracy is maintained even in the presence of ground loops and powerline hum.

TRUE SYSTEMS COMPATIBILITY

Isolated Programming & Output

The standard digital output and optional remote programming in every 4800 is fully isolated using a unique light emitting diode—photo transistor technique—no matter how the instrument is connected into your system the instrument's full 120 dB of common mode rejection is maintained. This means a 1,000,000 to 1 reduction in the errors caused by ground loops and powerline hum.

Solid State Programming & Output

The standard BCD output and optional remote programming of range, function and filter are accomplished by solid state circuitry. This ensures high reliability in systems applications and years of trouble-free service.

Built-in System Timing

The BCD output and remote programming capability of the 4800 is further enhanced by built-in time outs which allow for circuit settling times. This prevents "first reading" errors. After a command to read is given, an appropriate time delay (DC, 5 ms; ohms, 25 ms; AC, 400 ms; filter, 250 ms) is inserted before the DVM issues a print command, thereby ensuring that the BCD output data has the full accuracy of the instrument.

Speed

With a 4800 more than 18 readings (complete full scale step to 100% overrange) per second can be made on all measurements (including the mV preamplifier ranges) except AC. Operating in the AC function, the instrument is capable of making three complete readings per second.

Remote Override

The entire front panel can be overridden by the remote programming input. This provides systems protection by preventing erroneous readings often encountered when a front panel control has been placed in a non-remote position.

Front Panel Controls for Systems Checkout

The front panel controls on the 4800 greatly facilitate use of the instrument in a wide range of systems applications. Front or rear input, digital output, program control and a single read mode are some of the systems oriented features which are front panel selectable. An operator can now remove the 4800 from a system for manual use by merely resetting the data output and program control buttons. The instrument can be returned to system control just as easily.

Dana Series 4800 Specifications

DC VOLTAGE
(Included in basic instrument)

Full Range Display:	±.10000, ±1.0000, ±10.000, ±100.00, ±1000.0 V
Overrange:	100% on all ranges, ±1000 V maximum input
Resolution:	10 microvolts on 0.1 V range
Accuracy:	24 hours, 25°C ±1°C ±(0.01% of reading +0.01% of full scale) 90 days, 25°C ±5°C ±(0.01% of reading +0.01% of full scale) 6 months, 25°C ±5°C ±(0.02% of reading +0.01% of full scale)
Temperature Coefficient:	0°C to 50°C 1, 10, 100, 1000 Volt Ranges ±(0.001% of reading +0.001% of full scale)/°C 0.1 Volt Range ±(0.001% of reading +0.002% of full scale)/°C
Input Resistance:	0.1, 1, 10 Volt Ranges 10,000 megohms 100, 1000 Volt Ranges 10 megohms
Normal Mode Noise Rejection:	At or near line frequency Filter in: 100 dB (100,000 to 1) Filter out: 48 dB (250 to 1)
Common Mode Noise Rejection:	DC to 61 Hz (with 100Ω unbalance in either lead) Filter in: 140 dB (10,000,000 to 1) Filter out: 120 dB (1,000,000 to 1)
Settling Time:	To 0.01% from full scale step Filter in: 250 mS Filter out: 5 mS

mV/DC, DC/DC, AC/DC, Ω/DC RATIO
(Capability included in basic instrument)

Full Range Display: (ratio x 10)	mV/DC ratio range +10.000:1 DC/DC & AC/DC ratio ranges +.10000:1, +1.0000:1, +10.000:1, +100.00:1, +1000.0:1 Ω/DC ratio ranges 1.0000:1, 10.000:1, 100.00:1, 1.0000k:1, 10.000k:1, 100.00k:1, 1.0000M:1, 10.000M:1, 100.00M:1
Overrange:	100% on all ranges
Accuracy DC/DC:	90 days, 25°C ±5°C (add 0.01% of reading to get 6 month specification) ±[0.01% of reading +0.01 (10 V/ref input) % of full scale]
Reference Input:	Impedance: 1000 megohms Reference Range: +0.5 to 10.5 Volts Settling time: 250 mS to 0.01%

MILLIVOLTS DC
(With addition of Option 12 Preamplifier or Option 50 Ohms/Preamplifier)

Full Range Display:	10.000 mV, .10000V
Overrange:	100% on both ranges, ±150 V maximum input
Resolution:	1 microvolt on 10 mV range
Accuracy: 10 mV range*	24 hours, 25°C ±1°C ±(0.01% of reading +0.01% of full scale) 90 days, 25°C ±5°C ±(0.01% of reading +0.03% of full scale) 6 months, 25°C ±5°C ±(0.02% of reading +0.03% of full scale) *accuracy of 0.1 V range same as DC Volts
Temperature Coefficient:	0°C to 50°C 0.1 V range ±(0.001% of reading +0.001% of full scale)/°C 10 mV range ±(0.001% of reading +0.005% of full scale)/°C
Input Resistance:	10,000 megohms
Noise Rejection:	Same as DC Voltage
Settling Time:	Same as DC Voltage

TRUE 4-WIRE OHMS
(With addition of Option 50 Ohms Converter/Preamplifier)

Full Range Display:	1.0000, 10.000, 100.00 ohms, 1.0000k, 10.000k, 100.00k, 1.0000M, 10.000M, 100.00M ohms
Overrange:	100% on all ranges; ±30 VDC or 30V peak AC maximum input
Resolution:	100 microhms on 1 ohm range
Accuracy:	90 days, 25°C ±5°C (Multiply % of reading error by 1.5 to get 6 month specification) 10, 100, 1k, 10k, 100k, 1M ohm ranges ±(0.01% of reading +0.01% of full scale) 1 ohm range ±(0.01% of reading +0.05% of full scale) 10M ohm range ±(0.05% of reading +0.01% of full scale) 100M ohm range ±(0.20% of reading +0.01% of full scale)
Normal Mode Noise Rejection:	Same as DC Voltage
Settling Time:	To rated accuracy from full scale step 30 mS (300 mS 100 M range)

Current Through Unknown:	
1 ohm range	10 milliamperes
10 ohm range	10 milliamperes
100 ohm range	1 milliampere
1 kilohm range	0.1 milliampere
10 kilohm range	1 milliampere
100 kilohm range	0.1 milliampere
1 megohm range	10 microamperes
10 megohm range	1 microampere
100 megohm range	0.1 microampere

AC VOLTS TRUE RMS (Option 31 AC Converter)

Full Range Display:	.10000V, 1.0000V, 10.000V, 100.00V, 1000.0V RMS
Resolution:	0.01% of range, 10 μV on .1V range
Overrange:	100% (within maximum input voltage limit)
Maximum Input Voltage:	1000V DC/RMS or 1500V peak, decreasing to 20V RMS at 1 MHz. $2x10^7$ VHz maximum on any range
Maximum Crest Factor: (Pulses at 1 kHz Repetition Rate)	7:1 at full-scale 22:1 at 10% of full-scale
Accuracy:	90 days, 23°C ±5°C For inputs >500V multiply % of reading spec by (1+Vin/2000) 1 Hz operation available on special request
AC mode	20 Hz—30 Hz ±(.6% of reading +.03% of full scale) 30 Hz—50 Hz ±(.3% of reading +.03% of full scale) 50 Hz—100 Hz ±(.1% of reading +.03% of full scale) 1, 10, 100, 1000V range 100 Hz—20 kHz ±(.07% of reading +.03% of full scale) .1V range 100 Hz—20 kHz ±(.1% of reading +.03% of full scale) 1, 10, 100, 1000V range 20 kHz—50 kHz ±(.1% of reading +.1% of full scale) .1V range 20 kHz—100 kHz ±(1% of reading +.2% of full scale) 1, 10, 100, 1000V range 50 kHz—100 kHz ±(.2% of reading +.2% of full scale) 10, 100, 1000V range 100 kHz—300 kHz ±(3% of reading +.5% of full scale) 1V range 100 kHz—300 kHz ±(5% of reading +1% of full scale) 1, 10, 100V range 300 kHz—1 MHz Add ±[10 f(MHz)% of reading +.5% of full scale) to 300 kHz accuracy spec]
AC + DC Mode	Add .02% of full scale to AC specification.
Input Impedances: AC Mode	1 Megohm ±0.1% in series with 0.22 μF shunted by less than 100 pF to common
Common Mode Rejection:	With 100Ω unbalance in either lead DC to 60 Hz: 120 dB
Settling Time:	0 to Full Scale Step 300 msec Full Scale to 10% FS Step 400 msec

AC VOLTS RMS DISTORTION INSENSITIVE (Option 21 AC Converter)

Full Range Display:	.10000V, 1.0000V, 10.000V, 100.00V, 1000.0V
Resolution:	0.01% of range, 10 microvolt on 0.1V range
Overrange:	100% (within maximum input voltage limit)
Maximum Input Voltages:	1000V RMS decreasing to 20V RMS at 1 MHz. $2x10^7$ VHz maximum on any range.
Accuracy:	90 days, 23°C ±5°C (add 0.01% of reading to get 6 month specification) 1V to 1000V ranges
30 Hz to 50 Hz	±(.13% of reading +.02% of full scale)
50 Hz to 100 Hz	±(.08% of reading +.02% of full scale)
100 Hz to 5 KHz	±(.02% of reading +.02% of full scale)
5 KHz to 100 KHz	±(.05% of reading +.03% of full scale)
100 KHz to 300 KHz	±(.26% of reading +.08% of full scale)
300 KHz to 1 MHz	±(.51% of reading +.11% of full scale)
	.1V range
30 Hz to 50 Hz	±(.15% of reading +.08% of full scale)
50 Hz to 100 Hz	±(.1% of reading +.08% of full scale)
100 Hz to 5 KHz	±(.05% of reading +.08% of full scale)
5 KHz to 100 KHz	±(.07% of reading +.13% of full scale)
100 KHz to 300 KHz	±(.28% of reading +.28% of full scale)
300 KHz to 1 MHz	±(.53% of reading +.53% of full scale)
for V in >500V	and f<5 KHz, add ±.02% of reading and f≥5 KHz, add ±.08% of reading
Input Impedances:	1 megohm minimum in series with .22μF, shunted by less than 100pf.
Common Mode Rejection:	With 100Ω unbalance in either lead DC to 60 Hz
.1V range	120 db
1V range	120 db
10V range	100 db
100V range	80 db
1000V range	60 db
Settling Time:	0 to Full Scale Step 350 msec Full Scale to 10% Full Scale 500 msec

GENERAL

Conversion Technique:	Dual Slope
Signal Integration: Time: (60 Hz Standard)	16⅔ msec
Reference Integration Time:	0 to 33⅓ msec
Polarity Selection:	Automatic
Ranging:	Autoranging is standard, upranges at 200% F.S. and downranges at 10% F.S.
Read Rate:	3⅓ rdg per sec to hold
Common Mode Voltage:	500V guard to case with logic common tied to case. 250V analog common to guard.
Display:	4 full decades plus overrange digit plus decimal point and function annunciator
Overrange Indication:	Maximum reading is 20000 and "NO" annunciator is illuminated
Filter:	3-pole active
Analog Signal Output:	Signal input scaled and buffered 0 to ±20V. DC voltage is available for driving a recorder or as an accurate voltage source.
Power Requirement:	115V ±10% 50—400 Hz 40 watts Maximum • 220/240 volts optional
Weight:	16 lbs (7.3Kg) net • 18 lbs (8.2Kg) shipping
Dimensions:	3.5″x14″x16.75″ • 89 mm x 356 mm x 425 mm
Temperature Range:	Operating 0°C to 50°C • Storage —40°C to 70°C
Humidity Operating:	<75%; 25°C to 40°C • <50%; 40°C to 50°C
Fan:	Not required
Vibration Operating:	.025″ double amplitude to 50 Hz for 15 minutes
Guarantee:	12 months, faulty workmanship or component failure

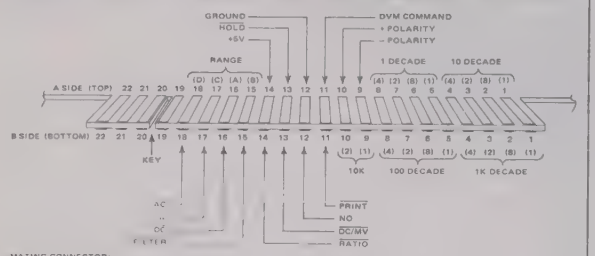
DATA OUTPUT
(Included in the Basic Instrument)

Information:	All BCD outputs of numerical data, 4-bit range code, function flags, polarity flags, special flags and logic supplies
Logic Type:	Standard TTL levels, 8-4-2-1 BCD
Command Mode:	Direct Command
Maximum Read Rate:	26 rdg per sec to full scale, 60 Hz operation
Isolation:	Data output common may be floated up to 200V peak from power line ground

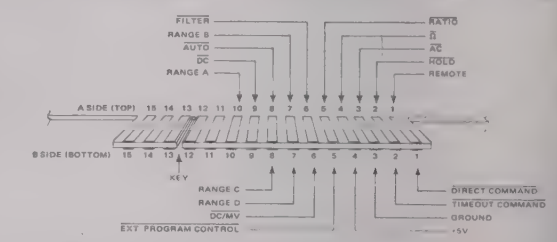
REMOTE PROGRAMMING
(Option 70)

Input Information:	Provides isolated programming of all DMM functions and ranges.
Logic Type:	Standard TTL levels, 8-4-2-1 BCD
Functions:	Function lines are programmed by a closure to ground (low TTL level)
Ranges:	4 range lines are 8-4-2-1 coded positive true logic
Command Modes:	Direct Command Timeout Command

PIN ASSIGNMENTS J201 DATA OUTPUT



PIN ASSIGNMENTS J202 PROGRAM INPUT



HOW TO ORDER INSTRUMENTS AND ACCESSORIES:

To order the 4800 DVM, provide a complete model number indicating both the basic instrument and all options and accessories that are to be included. The total cost is the sum of the individual items ordered.

Refer to Dana's Master Price List when ordering options and accessories separately.

Basic Instrument

Model 4800 Digital Voltmeter.....$1395
(Includes DC, ratio, electrical output, front/rear input, analog output)

Optional Functions and Programming

Model 01 Accessory Card	$ 150
*Model 12 Preamplifier for mVDC	$ 200
*Model 21 Distortion Insensitive AC Converter	$ 600
*Model 31 True RMS AC Converter	$ 575
*Model 50 4-Wire Ohms/Preamp for mV	$ 400
Model 70 Remote Programming	$ 200

*Requires Option 01

Miscellaneous Accessories

Input Cable, Part No. 402190	$ 20
Rack Mounting Flanges, Part No. 403402	$ 20
High Voltage Probe, Model No. 641	$ 275
Current Shunts, Model No. 651	$ 125

(All prices are in U.S. Funds and are subject to change without notice.)

DANA'S REPRESENTATIVE IN YOUR AREA:

DANA

Dana Laboratories, Inc., 2401 Campus Drive, Irvine, California 92664 U.S.A.
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Series 7500
Electronic Counters

DANA®

Others measure by us.

New standards of frequency and sensitivity at surprising prices.

Economy is seldom expected as a bonus in instruments offering the highest performance, versatility, and reliability. Yet that combination is precisely what the Dana 7500 frequency counters deliver. The 7500 Series counters provide cost/performance trade-offs which fit them to a wide variety of applications—economically.

1GHz with 10mV Sensitivity.

The 7580 frequency counter is capable of measuring frequencies as high as 1GHz with unique sensitivity. This model features UHF sensitivity of 10mV rms to meet the most demanding of applications, such as service and calibration of mobile communication equipment. Low level UHF signals can, therefore, be measured without external amplification that can increase measurement complexity and cost. Only 40ms is required to measure 1GHz with a resolution of 1 part in 10^7.

525MHz with 10mV Sensitivity.

For those applications that do not require the UHF capabilities of the 7580, Dana has designed the 7570. RF measurements to 525MHz can be made by this model with the same high sensitivity (10mV rms) as the 7580. Again these features meet the most demanding requirements in the communications industry.

20Hz to 200MHz Direct Count Capability.

Both the 7570 and 7580 provide high input impedance direct count capability to 200MHz. The front panel sensitivity control allows for adjustment of a wide range of input signals from 50mV rms to 250V rms. Input protection to 250V rms prevents accidental damage due to input fault voltages.

Frequency Ratio Measurements.

Frequency ratio measurements capability is standard on the 7500 Series counters. To achieve greater accuracy, the multiple ratio mode is employed through the scaling of the denominator by factors of 10^4 to 10^8 selectable in decade steps.

Optional BCD Output.

For permanent record keeping, an optional BCD output capability is available providing all the front panel read-out numerical information as well as the decimal point location and annunciator. Remote control is achieved through a hold line and a reset line.

Fused High Frequency Input Option.

An optional fused input circuit is available for use in environments where signal levels might exceed the maximum input level of the 50 ohm channel of the 7570 and of the 7580. This option provides overdrive protection to the high frequency channels, thus eliminating the possibility of costly damage to the input circuitry.

In-Range Light.

A standard feature on both the 7570 and 7580 is an in-range light located on the front panel of the instrument. This light notifies the operator when the input signal is of sufficient amplitude to be properly counted by the 525MHz/1GHz channels. This same detector circuit which drives the in-range light automatically enables the RF counting circuitry and disables the 200MHz high impedance channel.

AGC Input Circuitry.

The 50 ohm high frequency input channel on both the 7570 and 7580 frequency counters has AGC input circuitry which compensates for signal level variations of more than 40dB with no degradation in accuracy. This circuitry reduces the chance that high superimposed noise levels will exceed the hysteresis band limits of the counter and cause erroneous readings. Full accuracy is also maintained with up to 98% amplitude modulation on the input signal.

Rugged Construction.

The case is of die-cast aluminum, providing full protection to the unit for most infield applications. The front panel is recessed in the aluminum case to provide protection of all front panel controls and connectors from physical damage.

High-Speed Prescaler.

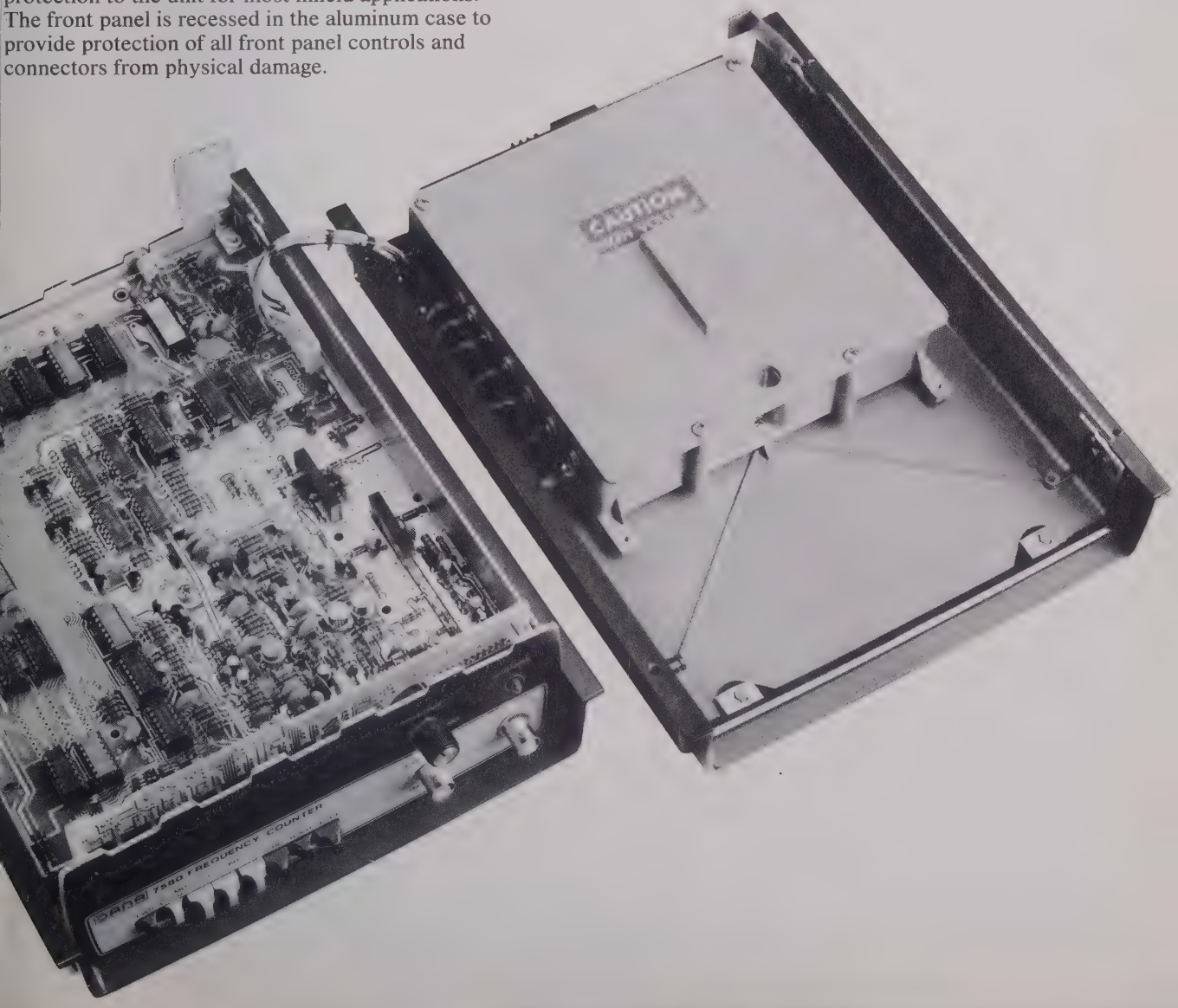
7570 uses a divide by 2 prescaler providing 1Hz resolution in just 2 seconds. The 7580 uses a divide by 4 prescaler which provides 1Hz resolution in only 4 seconds. These fast prescalers make high-speed, high-resolution circuit adjustments fast and easy—they make the 7500 series ideal in a data logging application.

Maintainability.

Simple, uncluttered circuitry, plus Dana's uniquely designed package, facilitates fast and easy servicing of the Series 7500 counters.

Operational Flexibility.

The 7500 Series counters are designed to operate from portable line power sources with less than 20 watts power consumption. This capability extends the counter's applications to in-field and remote locations uses, such as those found in the telecommunications industry.



Dana Series 7500 Specifications

Dana Model 7570 Frequency Counter

Frequency Range:	20Hz to 200MHz (F_A Input) 10MHz to 525MHz (F_C Input)
Accuracy:	±1 count ± reference error
Input Characteristics:	
F_A Input	
Sinewave Sensitivity:	50mV rms
Impedance:	1Mohm shunted by 25pf
Maximum Input:	250V rms to 10KHz
Voltage Range:	Continuously variable vernier control
F_C Input	
Sinewave Sensitivity:	10mV rms
Impedance:	50 ohm nominal
Maximum Input: (operating)	1V rms
Maximum Input: (without damage)	5V rms
Sinewave Sensitivity: (with overdrive protection)	15mV rms
Measurement Time:	10 milliseconds to 10 seconds, selectable in decade steps. F_C Input prescaled by 2.
Self Check:	1MHz
Frequency Ratio Measurements:	
F_A Input:	20Hz to 200MHz
F_B Input:	1KHz to 1MHz
Ratio Range:	$\frac{10^4 F_A}{F_B}$ to $\frac{10^8 F_A}{F_B}$
Multiplier:	F_B scaled by 10^4 to 10^8, selectable in decade steps.
Accuracy:	±1 count F_A ± trigger error of F_B
F_B Input:	Same as external reference input
Trigger Error:	$\frac{\leq .0075}{\text{slope (V/}\mu\text{S)}}\ \mu S$

Dana Model 7580 Frequency Counter

Frequency Range:	20Hz to 200MHz (F_A Input) 10MHz to 1GHz (F_C Input)
Accuracy:	±1 count ± reference error
Input Characteristics:	
F_A Input	
Sinewave Sensitivity:	50mV rms
Impedance:	1Mohm shunted by 25pf
Maximum Input:	250V rms to 10KHz
Voltage Range:	Continuously variable vernier control
F_C Input	
Sinewave Sensitivity:	10mV rms
Impedance:	50 ohm nominal
Maximum Input: (operating)	1V rms
Maximum Input: (without damage)	5V rms
Sinewave Sensitivity: (with overdrive protection)	15mV rms
Measurement Time:	10 milliseconds to 10 seconds, selectable in decade steps. F_C Input prescaled by 4.
Self Check:	1MHz
Frequency Ratio Measurements:	
F_A Input:	20Hz to 200MHz
F_B Input:	1KHz to 1MHz
Ratio Range:	$\frac{10^4 F_A}{F_B}$ to $\frac{10^8 F_A}{F_B}$
Multiplier:	F_B scaled by 10^4 to 10^8, selectable in decade steps.
Accuracy:	±1 count F_A ± trigger error of F_B
F_B Input:	Same as external reference input
Trigger Error:	$\frac{\leq .0075}{\text{slope (V/}\mu\text{S)}}\ \mu S$

GENERAL SPECIFICATIONS

Internal Reference Oscillator:	
Aging Rate:	$\leq 1 \times 10^{-6}$ per month
Temperature Stability:	$+2 \times 10^{-5}$, 0°C to 50°C
Voltage Stability:	$\pm 1 \times 10^{-7}$, ±10% line voltage change
Warm Up:	30 minutes
Optional TCXO	
Aging Rate:	$\leq 3 \times 10^{-7}$ per month
Temperature Stability:	$\pm 2.5 \times 10^{-6}$, 0°C to 50°C
Voltage Stability:	$\pm 1 \times 10^{-7}$, ±10% line voltage change
Warm Up:	30 minutes
Reference Output:	1MHz square wave, buffered, TTL compatible
External Reference:	1MHz, 1V rms into 1Kohm
Display:	LED; 7 digits standard, 8 digits optional
Reset:	Front panel reset push-button or remote TTL command clears counter and initiates new reading.
Hold:	Retains prior frequency reading until reset command initiates new reading.
Input/Output Connectors:	BNC
BCD Output (Optional):	1-2-4-8 TTL of front panel readout, including decimal point and annunciator.
Operating Temperature:	0°C to 50°C
Line Voltage:	115/230V ±10%, 50Hz-400Hz
Power Requirements:	20 watts, maximum
Weight:	3.6 kg.
Dimensions:	Half-rack

HOW TO ORDER INSTRUMENTS AND ACCESSORIES

To order the Dana Series 7500 frequency counter, provide a complete model number, indicating both the basic instrument and all options and accessories that are to be included. The total cost is the sum of the individual items ordered.

Refer to Dana's Master Price List when ordering options and accessories separately.

BASIC INSTRUMENT

Model 7570.....$ 799
Model 7580.....$1099

OPTIONS AND ACCESSORIES:

When ordering options and accessories, specify model number of the instrument with which they are to be used.

Example: To order Option 60 Rack Mounting Flanges for Model 7570, specify: Option 60 Rack Mounting Flanges for Model 7570.

OPTIONS:

08 – 8th Digit.....$ 75
21 – Optional TCXO.....$150
41 – Overdrive Protection.....$ 25
51 – BCD Output.....$100
60 – Rack Mounting Flanges.....$ 35

Prices and specifications subject to change without notice. Payable in U.S. Funds

YOUR NEAREST DANA REPRESENTATIVE:

DANA®
Dana Laboratories, Inc.,
2401 Campus Drive,
Irvine, California 92664.
Telephone (714) 833-1234, Teletype 910-595-1136, Telex 67-8341.
In Europe: Contact DANALAB INT'L Headquarters,
119/121 Rue Anatole France, 1030 Brussels, Belgium
Telephone: 02-241-4550/TLX: 846-23662. DANA B

Series 7000 Digiphase™ Synthesizer

DANA®

Others measure by us.

Versatility, accuracy and complete control.

The Dana Digiphase Synthesizer is the most versatile frequency synthesizer presently available, yet it offers surprising simplicity of operation. It is particularly applicable as a local oscillator in digitally tuned communications systems, where accurate frequencies and complete phase control are of prime importance.

The 7000 Synthesizer can be used for measurement of frequency or phase stability in the testing of components, discriminators, IF strips, and receivers. Because of its excellent spectral purity, wide frequency range, and high stability, the 7000 Series can also be used for standardization in calibration laboratories or as a local oscillator in radar systems.

Digiphase Synthesis.

Through the application of a unique design developed at Dana Laboratories, the Dana Series 7000 Digiphase Synthesizer provides the desirable features of both direct and indirect synthesizers. The result is precise, continuous digital control of both the frequency and phase of the output signal.

Resolution to 1μHz.

Front panel controls provide 1Hz resolution. In addition, it is possible to achieve much greater resolution by sequentially programming the standard 7010 or 7020.

Amplitude/Phase Continuity During Switching.

When the frequency is switched, amplitude and phase continuity are maintained. This spectrally clean switching characteristic is particularly desirable when digitally generating a frequency sweep.

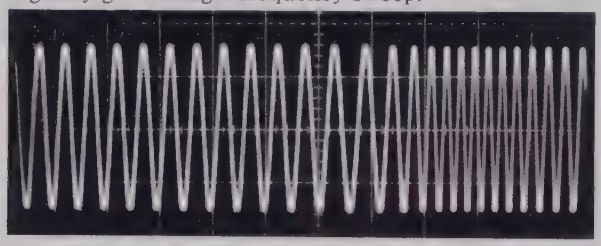


Figure 1

There are no switch transients during frequency sweeps.

Analog and Digital Phase Control.

In both the 7010 and 7020 models, the phase of the output signal can be modulated from −360 degrees to +360 degrees, using an external voltage. Linearity is better than .5 degrees.

Digital phase control, through remote programming, allows the phase of the output signal to be advanced in steps as small as .0036 degrees, within a time frame as short as 10 microseconds. Accurate phase relationships between digiphase synthesizers and external reference are realized.

Frequency Sweep.

When using model 7020, the frequency can be continuously varied or swept using an external voltage or a front panel control. This analog frequency variation or search is one decade symmetrically about any digitally selected frequency. Decade ranges from ±1Hz to ±100Hz can be selected without effecting resolution of the digitally selected frequency. Linearity is within 0.1% of full scale range.

Repeatable Precision Frequency Sweep.

Continuous digital control of both frequency and phase permits precise repetition of a frequency sweep. Since the output of the synthesizer is phase coherent with the reference, two synthesizers with the same reference may be simultaneously swept, while maintaining a specific frequency and phase relationship with each other.

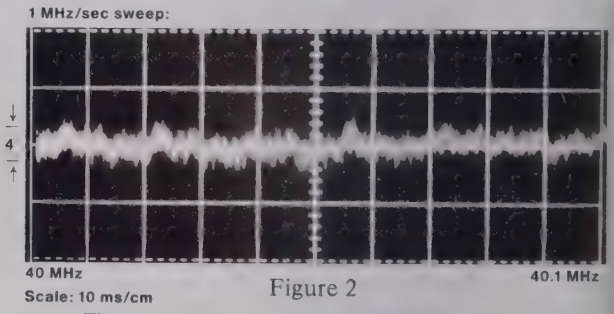
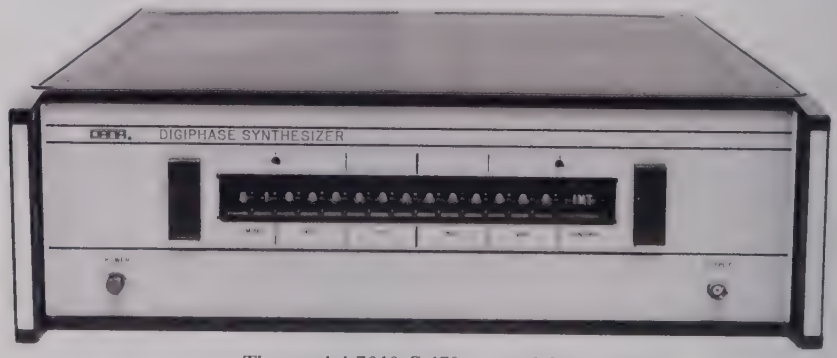
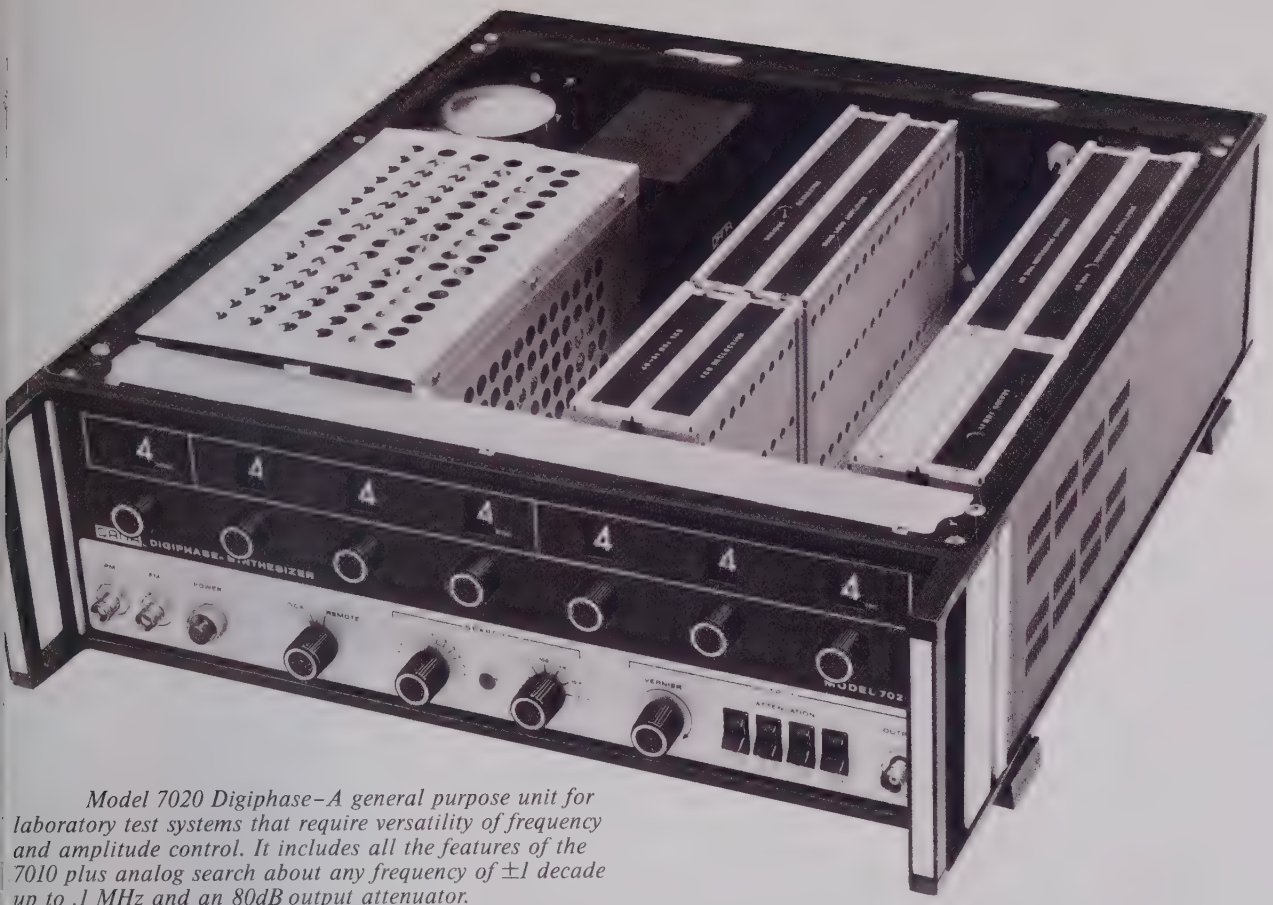


Figure 2

The mixed output of two synthesizers being swept simultaneously by the same programmer. Note the constant phase relationship.



The model 7010-S-179, a modified model 7010 providing resolution to 1 microHertz, with front panel or remote programming control.



Model 7020 Digiphase–A general purpose unit for laboratory test systems that require versatility of frequency and amplitude control. It includes all the features of the 7010 plus analog search about any frequency of ±1 decade up to .1 MHz and an 80dB output attenuator.

Low Phase Noise/Spurious Output.

Careful phase locked loop design maintains low phase noise. Spurious frequencies are phase modulation sidebands that have a predictable relationship to the frequency selected. Mixer spurs in the 11 MHz output are down 90dB and, in the 40 MHz to 51 MHz output, there are no mixer spurs.

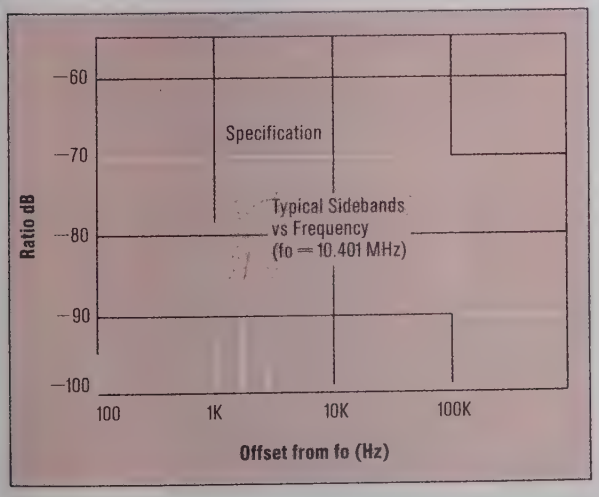


Figure 3

Series 7000 maintains low phase noise, and spurious frequencies have predictable relationship to the frequency selected.

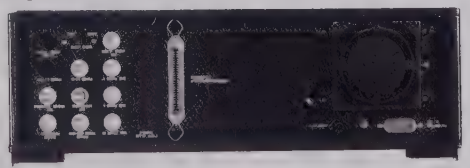
TTL Compatible BCD Programming.

BCD remote programming is standard in the 7000 Series and requires only 28 programming lines in order to program all 7 decades (versus the usual 70 lines required for conventional 10 line programming). The 7000 BCD is also TTL compatible, making the interface job much easier. For additional information, see Application Note 1, May, 1970.

Rugged IC Design/Modular Construction.

The Digiphase design dramatically reduces the complexity of frequency synthesizers by replacing RF components with integrated circuits. Consequently, vibration induced spurious responses have been greatly reduced.

The 7000 Series is built with plug-in modules which can be quickly removed for ease in servicing. In addition, all integrated circuits not in high speed circuits are mounted in sockets for easy trouble shooting and replacement. The entire instrument weighs only 34 pounds.



Model 7010 Digiphase–The basic unit for systems requiring a digitally controlled stable signal source. Frequency range is DC to 10,999,999 Hz in 1 Hz increments. Output voltage is 1V RMS into 50 ohm source. Can be locked to external 1 MHz or 5 MHz standard.

Dana Series 7000 Specifications

Frequency to 11 MHz

Frequency Range:	DC to 11 MHz
Smallest Step:	1 Hz (1μHz available)
Output Voltage:	
Maximum:	1V RMS into 50 ohms
Source Impedance:	50 ohms
Frequency Response:	±1 dB, dc to 11 MHz
Spurious Outputs:	
Non-harmonic:	-90 dB
Sidebands within fo ±100 kHz:	-70 dB
Harmonics of fo:	-30 dB
Signal to Phase Noise Ratios:	
Within fo ±15 kHz (excluding ±10 Hz from fo):	90 dB/Hz
Beyond fo ±15 kHz (excluding ±10 Hz from fo):	110 dB/Hz
Total in band fo ±15 kHz (excluding ±1 Hz from fo):	54 dB
Signal to AM Noise: fo ±15 kHz (excluding ±1 Hz from fo):	84 dB
RMS Fractional Frequency Deviation:	
10 mS average time:	3×10^{-9} (at 10 MHz)
1 sec average time:	3×10^{-11} (at 10 MHz)
Settling Time:	
Change in fo < 1 MHz:	500 μS
Change in fo > 1 MHz:	5 mS maximum

Frequency to 51 MHz

Frequency Range:	40 MHz to 51 MHz
Smallest Step:	1 Hz (1μHz available)
Output Voltage:	
Maximum:	0 dBm into 50 ohms
Source Impedance:	50 ohms
Frequency Response:	±1 dB, 40 to 51 MHz
Spurious Outputs:	
Non-harmonic:	-90 dB
Sidebands within fo ±100 kHz:	-70 dB
Harmonics of fo:	-10 dB
Noise Ratios:	
RMS Fractional Frequency Deviation:	
10 mS average time:	6×10^{-10} (at 50 MHz)
1 sec average time:	6×10^{-12} (at 50 MHz)
Settling Time:	
Change in fo < 1 MHz:	200 μS
Change in fo > 1 MHz:	5 mS maximum

YOUR NEAREST DANA REPRESENTATIVE:

GENERAL SPECIFICATIONS

Internal Reference Oscillator:	
Aging Rate:	$\pm 2 \times 10^{-7}$/day
Temperature Stability:	$\pm 2 \times 10^{-7}$/°C
Voltage Stability:	$\pm 1 \times 10^{-8}$/±10% Line
External Reference Input:	0.1 V into 100 ohms
Frequency:	1 MHz or 5 MHz
Auxiliary Square Wave Outputs:	100 kHz, 1 MHz, 5 MHz
Phase Modulation:	36°/volt (linearity ±0.1%)
Range:	±20 V
Bandwidth:	3 kHz
Frequency Search:	10 volts/decade (linearity ±0.1%)
Range:	±10 volts
Bandwidth:	3 kHz
Remote Programming:	
Code:	BCD (1-2-4-8)
Logic Levels:	"0" = 0 V ±0.5 V; "1" = 4 V ±1 V
Switching Time:	20 μS (10 μS synchronous)
Operating Temperature:	0°C to 50°C
Power Requirement:	105/115/125V, ±10%, 60 Hz 65 watts maximum
Weight:	34 lbs. (15.4 Kg)
Dimensions:	5-1/4"x16-3/4"x19-5/8" 133 x 425 x 498 mm
Guarantee:	12 months, faulty workmanship or component failure

High Stability Oscillator (with addition of Option 100)

Aging Rate:	$\pm 2 \times 10^{-9}$/day
Temperature Stability:	$\pm 2 \times 10^{-10}$/°C (0-50°C)
Voltage Stability:	$\pm 1 \times 10^{-10}$/±10% Line

HOW TO ORDER INSTRUMENTS AND OPTIONS:

To order the Dana Series 7000 Digiphase Synthesizer, provide a complete model number indicating both the basic instrument and all options that are to be included. The total price is the sum of the individual items ordered.

Refer to Dana's Master Price List when ordering options separately.

BASIC INSTRUMENT

Model 7010 . . . . . $6,995
Model 7020 . . . . . $7,495

OPTIONS

71-230V Operation . . . . . $ 450
04-50Hz Operation . . . . . $ 150
003-Rack Mounting Adapters . . . . . $ 20
020-Rear Output (no front output) . . . . . $ 100
100-High Stability Reference (± 2 x 10^{9}/day) . . . . . $ 750
High Resolution Option up to 1μHz available . . . . . factory quote

Prices and specifications subject to change without notice. Payable in U.S. funds.

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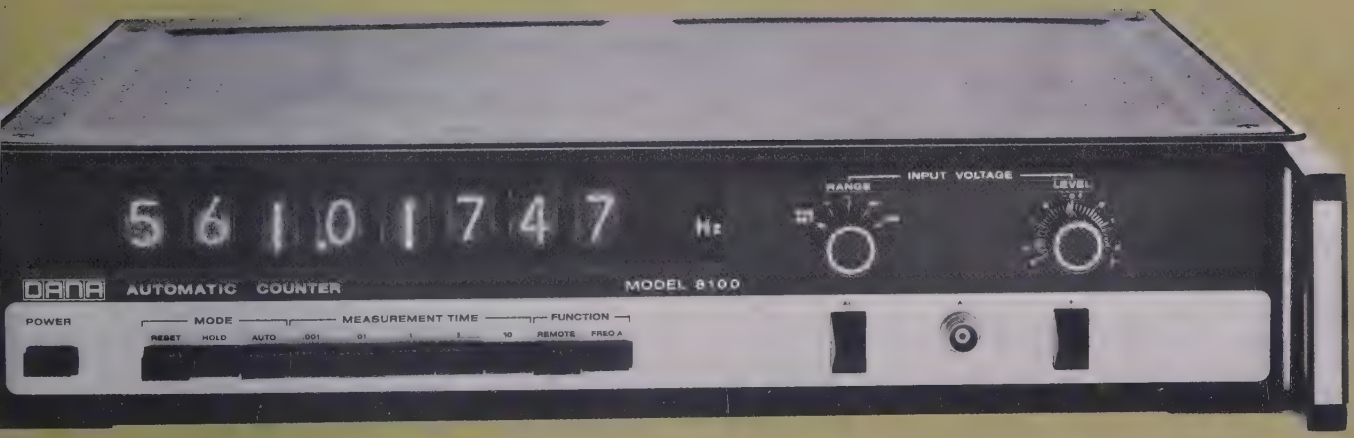
Available on GSA Contract No. GS-00S-26919

DANA
Dana Laboratories, Inc.,
2401 Campus Drive,
® Irvine, California 92664.
Telephone (714) 833-1234, Teletype 910-595-1136, Telex 67-8341.

Printed in U.S.A. September 1975

Made in U.S.A. 5320C

Series 8100 Automatic Counters



DANA®

Others measure by us.

8-Digit Resolution from 0.05 Hz to 500 MHz.

Automatic Counter Model 8110

Why buy an automatic counter? To get greater speed, resolution, and accuracy than any manual counter can offer.

With an automatic counter, you set a measurement time (not a gate time) and the counter does the rest.

The unique synchronous gating technique causes the instrument to count as many whole cycles of the unknown as possible in the selected measurement time, starting at the beginning of the first whole cycle after the command to read is given, and stopping at the end of the last whole cycle after the command to stop reading is given. The synchronous gate control also causes the reference signal to be counted during the exact same time period in which the whole cycles of the unknown are counted.

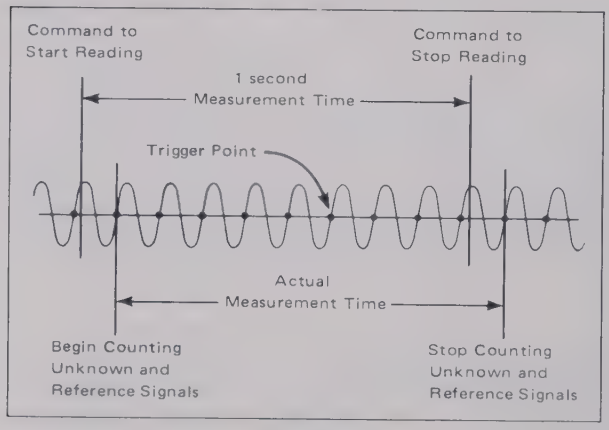

Command to Start Reading
Command to Stop Reading
1 second Measurement Time
Trigger Point
Actual Measurement Time
Begin Counting Unknown and Reference Signals
Stop Counting Unknown and Reference Signals

Figure 1

The computing circuitry then divides the whole number of counts of the unknown by the counts of the internal reference:

$$f_x = \frac{\text{counts of the unknown (exact whole number)}}{\text{counts of reference}}$$

In the 10 Hz example (Figure 1), the counter would accumulate exactly 10 counts of the unknown and 10 million counts, ±1 count of the internal reference. The display would now be: 10.000000 Hz. There are eight significant digits because we have divided an exact number by one with eight significant figures. The accuracy is ±0.00001%.

In the manual counter, the unknown frequency is counted for a specific gate time. This gate time is determined by dividing down the internal reference. A one-second gate time, for example, is derived in a manual counter which has a 10 MHz reference by dividing this reference by 10 million.

A 10 cycle signal measured for this one-second gate time would be read out as 10 ±1 count. On an eight-digit manual counter, the display would show: 00000010 Hz. The resolution is two significant digits and the accuracy is only ±10%.

The chart below compares the display and resolution differences between manual counters and automatic counters for a number of different frequency examples:

Reading on Manual Counter	Reading on Automatic Counter
00.000001 Mz	1.0000000 Hz
00.050000 Mz	50.000000 kHz
09.000000 Mz	9.0000000 MHz
1 second gate time	1 second measurement time

The automatic counter is also very fast.

If the measurement time in the 10 Hz example were cut to 100 ms, both the resolution and accuracy would be cut by a factor of 10 as well. This would occur in both the automatic and the manual counter. The manual counter, however, would now display only: 000000.01 kHz. This is just one significant figure: the ±1 count error causes the accuracy to be ±100%–an almost useless reading.

The automatic counter, however, would display: 10.00000 Hz. These are seven significant figures; the ±1 count error causes the accuracy to be ±0.0001%. This kind of speed is very important for rapid and easy adjustments of circuits or oscillators being measured.

Dana Series 8100 Automatic Counter Specifications

FREQUENCY MEASUREMENTS TO 50 MHz

(All Models)

Frequency Range	
DC Coupled	0.05 Hz to 50 MHz
AC Coupled	5 Hz to 50 MHz
Measurement Time	1 millisecond to 10 seconds, in decade steps
Accuracy	$\pm\left\{\left(\frac{2\times10^{-7}\pm\text{trigger level}}{\text{measurement time}}\right)\pm\text{ref. errors}\right\}$ of reading
Readout	Hz, kHz, MHz (ranging automatic)
Input Characteristics (Input A)	
Sensitivity	
Models 8100, 8110, 8120, 8130	
Sine Wave	10 mV rms
Pulse	30 mV p-p, 10 ns minimum pulse width
Model 8114	
Sine Wave	20 mV rms
Pulse	60 mV p-p, 10 ns minimum pulse width
Impedance	1 megohm, shunted by 25 pF
Maximum Input (Without Damage)	500 V, dc or peak ac, on any range
Selectable Input Voltage Range	0.1, 1, 10 and 100 V
Trigger Level	Continuously adjustable to ±300% of input-voltage range
Trigger Slope	Selectable + or −
Trigger Error	≤0.3/(S/N) (f_x) where S/N equals signal to noise ratio and f_x equals frequency of input signal
Present Conditions	0 trigger level, 1 V range, + slope, ac coupling
Trigger Output Marker(s)	
Models 8110, 8130	−12 V pulse, 1 microsecond wide, rear panel BNC
Models 8114, 8134	Negative going pulse, 15 V amplitude, rear panel BNC, duration equal to channel A trigger point to channel B trigger point

FREQUENCY MEASUREMENTS TO 500 MHz

(Models 8120, 8130)

Frequency Range	
AC Coupled	10 MHz to 500 MHz
Measurement Time	1 millisecond to 10 seconds, in decade steps
Accuracy	$\pm\left\{\left(\frac{2\times10^{-7}\pm\text{trigger level}}{\text{measurement time}}\right)\pm\text{ref. errors}\right\}$ of reading
Readout	MHz
Input Characteristics (Input C)	
Sensitivity, Sine Wave	1 mV rms
Impedance	50 ohms nominal
Maximum Input (Measurable)	1 V rms
Maximum Input (Without Damage)	5 V rms
Automatic Gain Control	Accommodates signals from 1 mV to 1 V rms
"In Range" Indicator	Lights if measurable signal is present

TIME-INTERVAL MEASUREMENTS

(Models 8110, 8130, 8114)

Time-Interval Range	100 nonoseconds to 10 seconds (100 seconds with option 004)
Accuracy	±100 nanoseconds ± trigger error ± reference errors
Resolution	100 nanoseconds
Readout	μSEC
Input Characteristics (Inputs A and B)	
"Start" Input	Input A, separate or common modes
"Stop" Input	Input B, separate mode; Input A, common mode
Sensitivity, Trigger, etc.	Same as for Input A, frequency measurements above

General Specifications (All Models)

INTERNAL REFERENCE OSCILLATOR CHARACTERISTICS:

Aging Rate	$\pm1\times10^{-7}$ per month
Temperature Stability	$\pm5\times10^{-7}$, 0°C to +50°C
Line Voltage Stability	$\pm5\times10^{-8}$, with 10% line voltage variation
Time Base Frequency Output	10 MHz 10 MHz square wave, buffered, TTL compatible
External Reference	1, 2.5, 5, or 10 MHz; 1 V rms into 1 kilohm; automatically locks to external reference if present
Display	Long-life digital display tubes; 8 standard; 9 optional (option 004)
Input/output Connectors	BNC
Operating Temperature	0° to 50°C
Line Voltage (±10%)	50 Hz to 60 Hz; 115 V rms
Power Requirement	55 watts maximum
Weight	Net, 15 pounds (7 KG) Shipping, 20 pounds (9 KG)
Dimensions (H x W x D)	3-15/32 x 16-3/4 x 14 inches 88.1 mm x 425 mm x 356 mm

SYSTEM INTERFACING

(Model 8114)

Program Inputs	
Binary Coded Commands	Function, Measurement time, input voltage range, trigger level
Single Line Commands	AC/DC, +/− slope, separate/common, hold/auto, reset
Logic Levels	Positive true, inputs are standard TTL gates
Trigger Level	
Analog	Supply ±10 V DC into 10 kilohms to set desired level; accuracy is ±5% of range ±1% of range per °C
Digital	4-bit code, 16 steps, 20% of range per step ±140% of range, maximum; accuracy is ±10% of range ±1% of range/°C
Electrical Outputs	
Binary Coded Data	1-2-4-8 code, each data digit, plus one digit for range
Single Line Signals	Print, gate, hold/auto
Logic Levels	Positive true, from standard TTL integrated circuits

Dana Series 8100 Automatic Counters. Six Versatile Models to choose from.

Model No.	Price	Frequency to 50 MHz	Time Interval	Frequency to 500 MHz	System Interface
Model 8100	$2195	■			
Model 8110	$2495	■	■		
Model 8120	$3295	■		■	
Model 8130	$3595	■	■	■	
Model 8114	$3095	■	■		■

Options	Option	Price
Electrical Output for Models 8100, 8110, 8120, 8130 (See System Interface)	500	$125
Rear Inputs (No Front Inputs)	010	$ 40
Rack Mount Adaptors	003	$ 20
Add 9th Digital Display Tube	004	$ 75
Mating Cable to HP5050B Printer	PN406389	$ 50
230V Operation	71	$100
50 Hz Operation	04	N/C

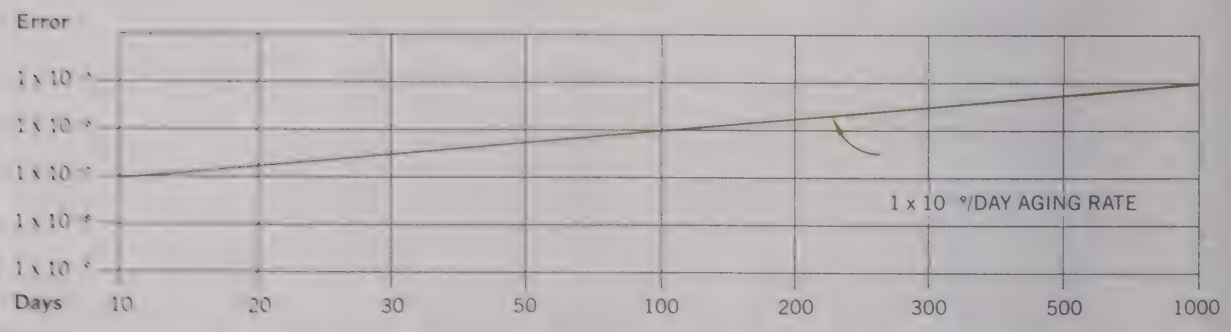
Oven Oscillators Option

Aging Rate Per Day	Aging Rate Per Month	Warmup*	0° to 50°C Temperature Stability	±10% Line Voltage Stability	Option	Price
1 x 10 ⁻⁹	3 x 10 ⁻⁸	72 hours	±5 x 10 ⁻⁹	±2 x 10 ⁻⁹	200	$400

*Time to reach specified aging rate after 24 hours off.

(All Prices are in U.S. funds and are subject to change without notice.)

REFERENCE FREQUENCY ERROR VS. TIME



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now available
FULL SYSTEMS CAPABILITY
including
DIGITAL TRIGGER LEVEL PROGRAMMING

Series 8000B Electronic Counters

• 50 mV sensitivity to 100 MHz • 1 mV sensitivity to 550 MHz
• 10 ns "one-shot" resolution • digital trigger level programming
• high trigger level stability • 150 ps resolution in t.i. average

DANA®

When measurements count
...count on Dana.

Series 8000B Electronic Counters

Versatility

Dana's 8000 series of electronic counters consists of five different models... Each model has been designed and developed to provide measurement capability for any application that requires an economical, reliable, and versatile digital electronic counter. Each model is self-contained, eliminating the need for multiple plug-ins.

Full Systems Capability

Full systems capability is available on the 8000B series counters. Now you can digitally program *all* counter functions including trigger level (analog trigger programming also available). The entire front panel controls of the 8000B can be remotely controlled.

Counter model number	Frequency Range		Time Interval		T.I. Ave.	Period	Period Ave.	Totalize	Frequency Ratio
	direct 0-150M	pre-scaler 1-550M	10 ns-10^9 s	100 ns-10^{10} s	150 ps-10^2 s	100 ns-10^{10} s	100 ns-10^2 s	0-10^9	10^{-9} 10^9
8010B	■			■	■	■	■	■	■
8015B	■		■			■	■	■	■
8020B	■	■				■	■	■	
8030B	■	■		■	■	■	■	■	■
8035B	■	■	■			■	■	■	■

Electronic Counter Model 8015B

8-Digit Accuracy.

An 8-digit display and a high stability reference oscillator provide the standard series 8000 counter with capability to make meaningful frequency measurements to an accuracy up to 1 part and 10^8. For more demanding applications, a 9-digit display with corresponding high stability reference oscillators is available as an option.

High Stability, Fast Warm-up Time Base.

The standard temperature compensated crystal oscillator (TCXO) in the Series 8000B counters serves as an ideal reference for maximum versatility and accuracy in a general purpose counter. The average aging rate is 3×10^{-7} per month. Since no temperature-controlled oven is used, extended warm-up times are not required when moving the counter from one location to another.

Ultra-high Stability Time Base Available.

Two higher stability reference oscillators are available. The option 200 oscillator provides an ultra-stable time base extending the time between calibrations and serves as a secondary frequency standard. This oven oscillator is in continuous operation whenever the counter is attached to the power line. The option 050 is a temperature compensated crystal oscillator (TCXO). It has the same fast warm-up characteristic as the standard oscillator but has a superior aging rate of 1×10^{-7} per month.

550 MHz Frequency Capability

1 mV Sensitivity

8020B, 8030B, and 8035B have RF measurement capability with unique sensitivity. These counters feature state-of-the-art broad band RF amplifiers, enabling meaningful measurements as low as 50 mV with the standard pre-scaler, or as low as 1 mV (−47 dBm) with an optional pre-scaler (Option 030). Low level RF signals can therefore be measured without external amplification that can increase the measurement cost and complexity.

Automatic Operation.

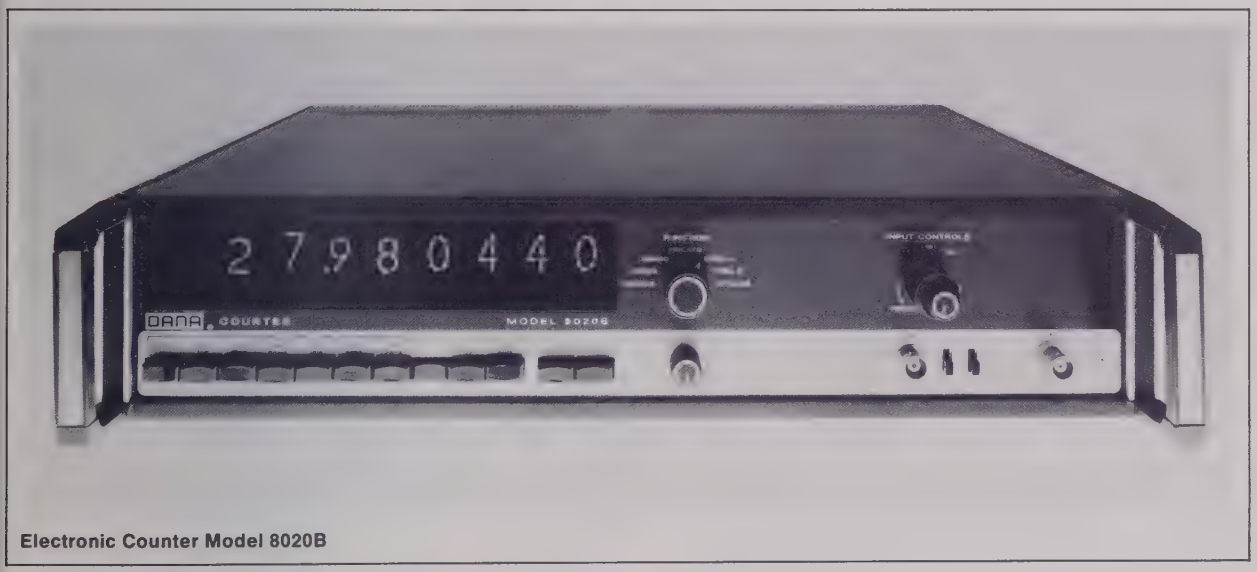
To measure frequencies between 1 and 550 MHz, the operator simply connects the unknown signal to the input and reads the result. By using a pre-scaler, both the need for manual tuning and the possibility of an incorrect setting have been eliminated. Triggering is automatically optimized for input signal amplitude from 50 millivolts to 1 volt with the 8000B's standard pre-scaler, or from 1 millivolt to 1 volt with the optional pre-scaler (Option 030).

Direct Readout of Carrier Frequency with AM or FM.

A wide band automatic gain control, coupled with excellent sensitivity, allows the measurement of the carrier frequency of an amplitude modulated signal. Full accuracy is maintained with greater than 90% amplitude modulation (99% with optional pre-scaler). Frequency modulated carriers can also be measured, as long as the frequency components are within the 1 to 550 MHz bandwidth.

High Accuracy Measurements without Delay.

Models 8020B, 8030B and 8035B are equipped with a 550 MHz pre-scaler. The pre-scaler maintains the stability and accuracy of the basic 150 MHz counter at radio frequencies. Only 40 milliseconds are required to measure 550 MHz to a resolution of 2 parts in 10^{-7}. This fast measurement time is due to the pre-scaler's capability to divide the input signal and multiply the measurement time by four.



Electronic Counter Model 8020B

Reliability and Maintainability.

A high performance instrument, regardless of its specifications, is not useful unless it operates dependably and properly.

All Silicon Circuitry.

To ensure highest reliability, we have used silicon solid state circuitry exclusively in our Series 8000B counters.

High Temperature Aging.

All integrated circuits are tested prior to installation. Before being shipped, every counter is given a 60-hour run-in at 50°C, a 2.5 G vibration test, and a 24-hour run-in at room temperature. These extensive quality control procedures isolate and correct infant component failures.

Plug-in IC's.

To facilitate maintenance, we have equipped each counter with IC sockets for accepting plug-in components. Should an integrated circuit malfunction, this feature permits easy isolation and replacement of the faulty component. No soldering is necessary. All integrated circuits are commercially available from local distributors. We do not use specially selected or in-house integrated circuits with limited availability.

Time Interval Measurements.

10 Nanosecond Resolution for "One Shot"

The time interval resolution of the 8015B and 8035B counters is 10 nanoseconds. Two independent channels determine the start and finish of the measurement. This permits the time between events occurring in different circuits to be measured in a straightforward way. Pulse width and rise time on non-repetitive waveforms can be measured to 100 nanosecond resolution with all counters in this series except the 8020B.

50 Millivolt Sensitivity.

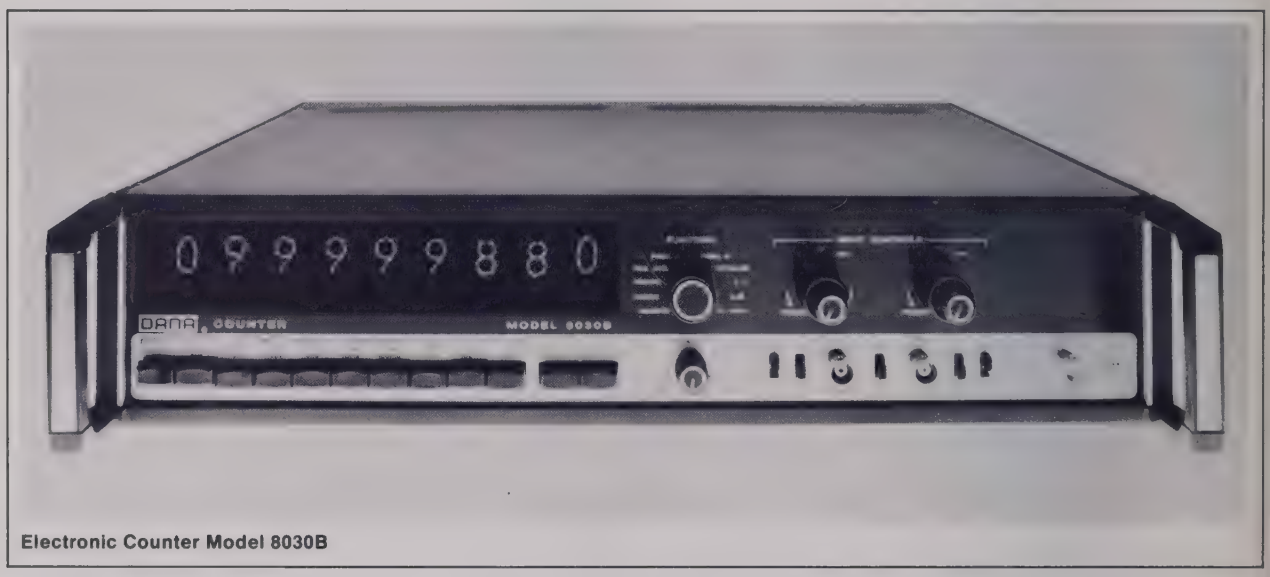
The use of low noise FET input circuitry provides 50 millivolt sensitivity to 100 MHz with a constant 1 megohm input impedance on both the start and stop input channels. The input circuitry includes a three-position attenuator and controls for trigger level, slope, and coupling. This allows triggering to be optimized for non-sinusoidal waveforms.

Time Interval Averaging for 150 ps Resolution.

With time interval average capability in the 8010B and 8030B, measurement accuracy and resolution can be improved when measuring repetitive signals. Propagation delays through integrated circuits can be measured to resolutions of 150 ps when the input signal is asynchronous with respect to the counter time base.

Analog Output for Accurate Setting of Trigger Levels.

Two analog outputs are provided on all models with time interval capability for accurately monitoring trigger level settings. By measuring the analog voltage outputs with a voltmeter, 50% point and 10%-90% rise time points can be set accurately and monitored in real time—while the time interval measurement is made.



Electronic Counter Model 8030B

Stable Trigger Controls.

Because we use high stability input amplifiers, trigger levels will drift less than 5% of full scale over a 10°C temperature range and 200 hours of operating time. Frequent adjustments are not necessary during the instrument warm-up period or when changes in temperature occur.

Continuous Marker Output.

While making a time interval measurement, it is often useful to observe the waveform under test with an oscilloscope. Series 8000B's marker output may be connected to most oscilloscopes to provide a continuous brightening of that portion of the waveform between the start measurement point and the stop point. Dana's technique obsoletes the ambiguous "dot-dot" markers found on most counters.

Systems Capability.

Programming Option 009.

This option provides complete digital programming. Even the trigger levels are digitally programmable. All front panel controls, including trigger levels, can be programmed from remote locations. Trigger levels can be set by either analog voltage or a 7-bit binary code that establishes 128 discrete trigger levels. The option also includes complete digital output.

Programming Option 008.

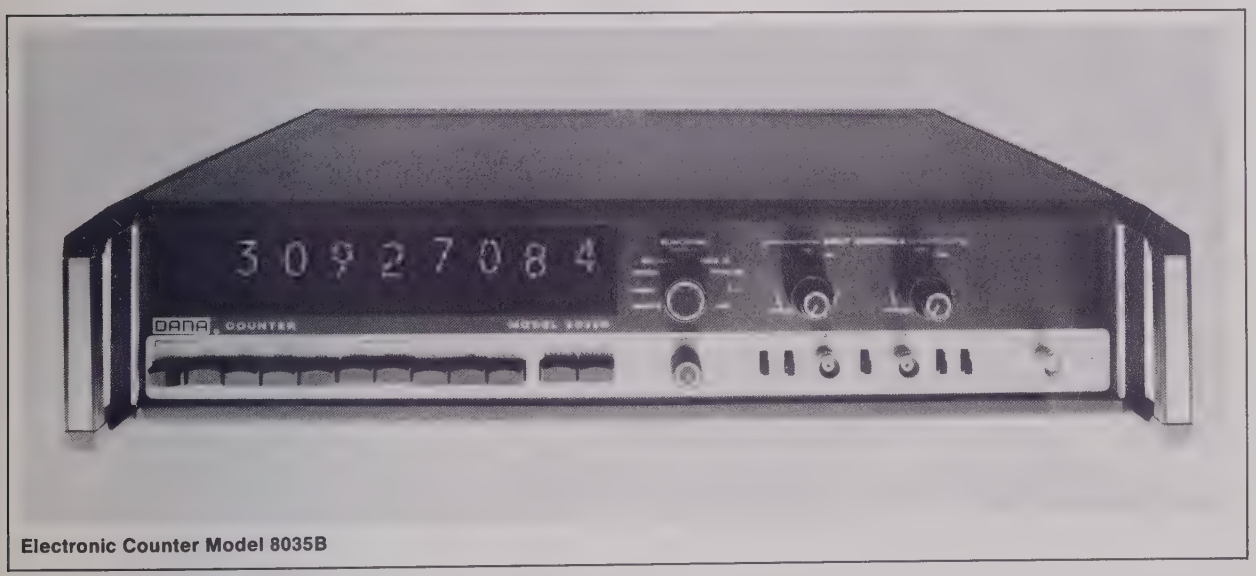
Option 008 is a systems interface including BCD output and remote programming input. It provides digital programming of many front panel controls as well as analog voltage control of the trigger level. Full BCD output is also provided.

TTL Systems Interface.

All remote programming and BCD outputs are compatible with TTL logic levels. This allows Series 8000B counters to be interfaced directly to control and recording devices without level shifting and buffer circuitry.

Remote Override.

All front panel controls can be overridden by the system control and hold inputs. This provides system protection by preventing erroneous readings which are often encountered when a control has been placed in a non-remote position. This feature is included with the programming option 009.



Electronic Counter Model 8035B

Control	Option 008 Programming	Option 009 Programming
Function	Single line	4 line-binary
Time base	Single line	4 line-binary
Start/stop	Single line	Single line
Hold/reset	Single line	Single line
Sep/com	Front panel only	Single line
+/− Slope	Single line	Single line
AC/DC coupling	Front panel only	Single line
Input range	Front panel only	2 line-binary
Trigger level	Analog voltage	7 line-binary and/or analog voltage
System override	Not available	Single line

Dana Series 8000B Specifications

Frequency Measurements to 150 MHz (All Models)	
FREQUENCY RANGE: DC coupled	0 to 150 MHz
AC coupled	10 Hz to 150 MHz
ACCURACY:	± 1 count ± reference error
INPUT:	Channel A
INPUT CHARACTERISTICS:	
Sensitivity, sine wave	50 mV rms to 100 MHz; 100 mV rms to 150 MHz
Sensitivity, pulse	150 mV peak; 4 nsec minimum width
Impedance	1 megohm shunted by 25 pF
Maximum input (without damage)	250 V rms or 300 V peak on all ranges except 150 V rms or 200 V peak to 1 MHz on 1 V range
Voltage ranges	1, 10, 100 selectable
Trigger level	Continuously adjustable to ±300% of input voltage range
Trigger slope	+ or −, selectable
Preset condition	0 trigger level
MEASUREMENT TIME:	1 μsec to 100 seconds, selectable in decade steps
DISPLAY:	8 digits (optional 9 digits), KHz or MHz
SELF CHECK:	10 MHz

Frequency Measurements to 550 MHz (Models 8020B, 8030B, 8035B)	
FREQUENCY RANGE: AC coupled	1 MHz to 550 MHz
ACCURACY:	± 1 count ± reference error
INPUT:	Channel C
INPUT CHARACTERISTICS:	
Sensitivity, sine wave	50 mV rms (1 mV with optional 030 pre-scaler)
Impedance	50 ohms nominal
Maximum Input (operating)	1 V rms
Maximum Input (without damage)	5 V rms
Automatic Gain Control	26 dB without adjustment (60 dB with option 030)
MEASUREMENT TIME:	Expands by 4 (4 μsec to 400 sec)

Time Interval Measurements (Models 8010B, 8015B, 8030B, 8035B)	
RANGE: (8015B, 8035B)	10 nsec to 10^8 sec (10^9 sec with option 004)
(8010B, 8030B)	100 nsec to 10^9 sec (10^{10} sec with option 004)
RESOLUTION: (8015B, 8035B)	10 nsec
(8010B, 8030B)	100 nsec
ACCURACY: (8015B, 8035B)	± 1 count ± reference error ± trigger error*
(8010B, 8030B)	± 1 count ± reference error ± trigger error*
INPUT: separate mode	Channel A start and Channel B stop
common mode	Channel A start and stop
INPUT CHARACTERISTICS:	Channel A and B same as described in Frequency Ratio Mode
DISPLAY:	μsec, msec, sec

Time Interval Average (Models 8010B, 8030B)	
RANGE:	150 psec to 10 sec (100 sec with option 004)
ACCURACY:	$\pm$ reference error $\pm$ 2 nsec $\pm \frac{\text{(trigger error* } \pm \text{ 100 nsec)}}{\sqrt{\text{No. of Intervals Averaged}}}$
INPUT:	same as time interval
INTERVALS AVERAGED:	1 to 10^8, selectable in decade steps
DISPLAY:	nsec, μsec
DEAD TIME:	Minimum time between stop and start: 200 nsec

Period Measurements (All Models)	
RANGE:	100 nsec to 10^9 sec (10^{10} sec with option 004)
RESOLUTION:	100 nsec
ACCURACY:	± 1 count ± reference error ± trigger error**
INPUT:	Channel A
DISPLAY:	μsec, msec, and sec

*Trigger error $< \frac{0.0025\ \mu\text{sec}}{\text{Signal Slope (V/}\mu\text{sec)}}$

Dana Series 8000B Specifications

Period Average (All Models)

RANGE:	100 nsec to 10 sec (100 sec with option 004)
ACCURACY:	$\pm$ 1 count $\pm$ reference error $\pm$ $\frac{\text{trigger error}^{**}}{\text{No. of periods averaged}}$
INPUT:	Channel A
PERIODS AVERAGED:	1 to 10^8 selectable in decade steps
DISPLAY:	nsec, μsec, msec

Frequency Ratio Measurements (Models 8010B, 8015B, 8030B, 8035B)

FREQUENCY RANGE:	
Input F_A	0 to 150 MHz
Input F_B	0 to 10 MHz
RATIO RANGE:	10^{-8} to 10^8 (10^9 sec with option 004)
MULTIPLIER:	F_B scaled by 1 to 10^9 selectable in decade steps
ACCURACY:	$\pm$ 1 count of F_A $\pm$ trigger error of F_B
DISPLAY:	Dimensionless

Totalize Measurements (All Models)

FREQUENCY RANGE:	0 to 150 MHz
COUNT RANGE:	0 to 10^8 (10^9 sec with option 004)
ACCURACY:	$\pm$ 1 count

Scaling (All Models)

FREQUENCY RANGE:	0 to 150 MHz
SCALING RANGE:	10 to 10^{10} selectable in decade steps

General Specifications (All Models)

INTERNAL REFERENCE OSCILLATOR CHARACTERISTICS:	
Aging Rate	$< 3 \times 10^{-7}$ per month
Temperature Stability	$\pm 2.5 \times 10^{-6}$, 0°C to +50°C
Voltage Stability	$\pm 1 \times 10^{-7}$, with 10% line voltage variation
Time Base	.01 Hz to 10 MHz selectable in decade steps
Output	10 MHz square wave, buffered, TTL compatible
EXTERNAL REFERENCE:	
8015B, 8035B	5 or 10 MHz — 1V rms into 1 kilohm; selectable
8010B, 8020B, 8030B	1, 5, or 10 MHz — by internal/external switch
MARKER OUTPUT:	Negative-going pulse, 15 volt amplitude, rear BNC, duration equal to channel A trigger point to channel B trigger point
DISPLAY:	Long-life digital display tubes; 8 standard, 9 optional (option 004)
INPUT/OUTPUT CONNECTORS:	BNC
OPERATING TEMPERATURE:	0° to 50°C
LINE VOLTAGE:	50 Hz to 400 Hz; 115V $\pm$ 10%
POWER REQUIREMENT:	60 watts maximum
WEIGHT:	Net, 15 pounds; shipping, 20 pounds
DIMENSIONS (HxWxD):	$3^{15}/_{32} \times 16^{3}/_{4} \times 14$ inches; 88x425x356 millimeters

Systems Interface Option 008 (Optional on All Models)

PROGRAMMING INPUTS:	
Single Line Commands	Function, time base, external gate, +/– slope, hold, reset
Logic Levels	Low TTL level or contact closure to ground for single line commands, inputs are TTL gates
Analog	Supply $\pm$10V into 10 kilohm to set desired level; accuracy is $\pm$5% of input range
ELECTRICAL OUTPUTS:	
Binary Coded Data	1-2-4-8 code, each data digit
Single Line Signals	Print, units, decimal point
Logic Levels	Positive true, from standard TTL integrated circuits

**Trigger error $\leq \frac{0.3}{(S/N)Fa}$ where S/N equals signal to noise ratio and Fa equals frequency.

(All specifications are subject to change at manufacturer's discretion.)

Systems Interface Option 009 (Optional on 8010B, 8015B, 8030B & 8035B)

PROGRAM INPUT:

Logic levels: All digital command lines are initially biased "high." Control settings are made by "pulling" the appropriate lines to ground. Inputs are standard TTL gates.

Trigger levels:
Analog (Option 008, 009)
± 30 VDC supply voltage (.1V per % of range) into 10 kilohms to set desired level.
Digital (Option 009)
7-bit code, 128 steps (including 0V), 5% of range per step, ± 300% of range.

ACCURACIES: The specifications for all remotely selected instrument functions, except trigger levels, are the same as for local selection.

Analog trigger level:
± 2% of range ± .2% of range per °C

$$\pm \left[\left\{ \frac{\text{Slope}\left(\frac{V}{\mu Sec}\right)}{\text{Range}} \right\}^{\frac{1}{2}} \right] \% \text{ of range}$$

± Attenuator error.

Digital trigger level:
± 5% of range ± .2% of range per °C

$$\pm \left[\left\{ \frac{\text{Slope}\left(\frac{V}{\mu Sec}\right)}{\text{Range}} \right\}^{\frac{1}{2}} \right] \% \text{ of range}$$

± Attenuator error.

Attenuator Error:

Accuracy (% of Range)

Frequency	Range		
	x 1	x 10	x 100
0 KHz—1 KHz	1	2	3
1 KHz—10 KHz	1	4	4
10 KHz—100 KHz	1	8	8
100 KHz—1 MKHz	1	8	8

Prices: 8000B Counters

8010B Freq. to 150 MHz, Time Interval 100 ns	$1495
8015B Freq. to 150 MHz, Time Interval 10 ns	1995
8020B Freq. to 550 MHz	1595
8030B Freq. to 550 MHz, Time Interval 100 ns	1895
8035B Freq. to 550 MHz, Time Interval 10 ns	2495

Options

003	Rack-Mounting Adaptors	20
004	Add 9th Digit Display Tube	75
008	Systems Interface	125
009	Full Systems Interface	700
010	Rear Input	25
030	1 mV 500 MHz Pre-scaler	400

Oscillator Options For All Models

Aging Rate Per Day	Aging Rate Per Month	Warmup*	0° to 50°C Temperature Stability	±10% Line Voltage Stability	Option	Price
——	1×10^{-7}	1 hour	$\pm 5 \times 10^{-7}$	$\pm 5 \times 10^{-8}$	050	$195
1×10^{-9}	3×10^{-8}	72 hours	$\pm 5 \times 10^{-9}$	$\pm 2 \times 10^{-9}$	200	$350

*Time to reach specified aging rate after 24 hours off.

All prices are in U.S. funds and subject to change without notice.

DANA'S REPRESENTATIVE IN YOUR AREA

DANA Dana Laboratories, Inc., 2401 Campus Drive, Irvine, California 92664, U.S.A.
Telephone (714) 833-1234, Teletype 910-595-1136, Telex 678-341

Series 9000 Microprocessing Timer/Counter

DANA®

Others measure by us.

Series 9000 Microprocessing Electronic Counters with Keyboard Control.

Dana's 9000 Series is the world's most advanced line of electronic timer/counters. Microprocessing control provides all the features of a premium timer/counter, a reciprocating counter, and a calculator, plus operating capabilities and interfacing options never before available in one instrument.

Keyboard Control.

The two 9000 models feature calculator-type keyboards for function control, rather than traditional knobs, buttons or switches. The keyboard is located in a front panel drawer and disappears from view when not in use. LED displays are used as status indicators to display function, measurement time, system control, external reference, input voltage range, slope, coupling and separate/common status.

Digital Trigger Level Readouts.

In addition to the eleven-digit readout, two 3-digit readouts continuously display the trigger level settings for both channels A and B.

Automatic Operation.

Because of microprocessing control, any measurement can be made at a touch of a button. The counter then automatically selects the appropriate gate time or multiplier to provide a "quick" reading. More or less resolution can then be selected through a single keyboard entry. For frequency and period measurements, both the voltage range and trigger level can also be automatically set to minimize measurement errors.

9-Digit Resolution.

Now full 9-digit resolution is available for most measurement situations. With its calculating capability, the 9000 can be used as either a universal timer/counter, or a reciprocating counter, or even as a preset counter to achieve maximum measurement resolution.

Full Measurement Capability.

Both the Model 9015 and 9035 provide full measurement capability to 100MHz: frequency, period, period average, time

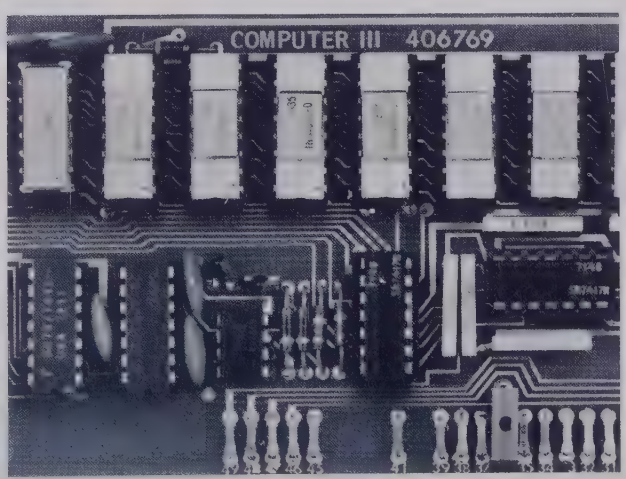
interval, time interval average, frequency ratio, and totalize. In addition, the 9035 provides prescaled frequency measurement capability to 512MHz.

Arithmetic Capabilities.

Direct readout in engineering units, reciprocal calculations, and "preset" operations are easily achieved with the 9000's microprocessing control. Constants with 9-digit resolution can operate on measurements, all through keyboard entry.

Four System Interfacing Options.

To meet both today's and tomorrow's system interfacing requirements, four options are available: the General Purpose Interface Bus (GPIB), Serial ASCII for teletype interfacing, parallel BCD output, and a high speed computer interface for situations where customized interfacing is required for high speed data transmission.

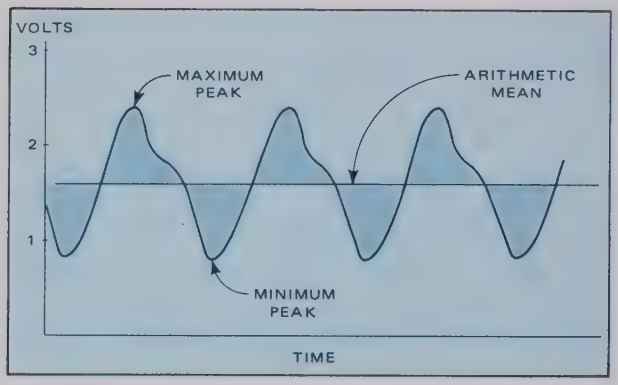


Microprocessing Power on the Bench.

The Series 9000 brings systems computing power to the bench. Digital trigger control, 9-digit resolution from near DC to 512MHz, automatic calculation of pulse width and rise/fall times – these are just a few examples of the many special capabilities of this powerful counter. In addition to these many new features, both the Model 9015 and 9035 provide full frequency, period, and time interval measurement capability to 100MHz.

Digital Trigger Level Control.

Trigger levels are easily set by entering their values on the keyboard. The correct voltage range is automatically selected. Two 3-digit LED readouts display the entered trigger levels and annunciators display the range, as well as coupling and slope status. Thus, you no longer have to depend on old-fashioned analog pots or imprecise external voltages to set trigger levels. This eliminates the need for additional equipment, such as oscilloscopes with all their built-in inaccuracies. Now, you just tell the counter the values, and it will do the rest.

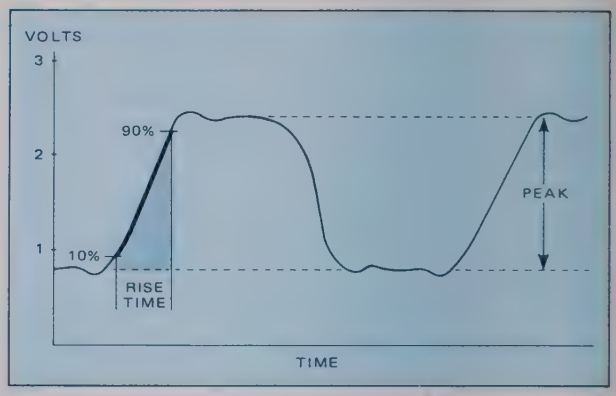


Automatic Trigger Setting.

It is often necessary to measure parameters, such as frequency, on signals of unknown magnitude. In the past the operator had to "hunt" with the trigger controls to make a measurement. Now the 9000 microprocessor takes out the guess work. Simply push the "auto" button and the counter's microprocessor takes over. It first sets the voltage range to 100 and scans the signal to see if its peak is greater than 30 volts. If not, the microprocessor automatically downranges the voltage range to 10 and again scans the signal. If the signal is still too small to be optimally measured, the microprocessor then sets the voltage range to 1. During the scan, the microprocessor measures the maximum peak and the minimum peak of the input signal. It then calculates the arithmetic mean of the two values and sets the trigger level to the mean. With the trigger level set to the mean, trigger errors or false counting due to noise on the input signal are minimized during frequency and period measurements.

Automatic Measurement: Rise/Fall Time and Pulse Width.

Before the Dana 9000 Series, the measurement of rise/fall time or pulse widths required a frequency



counter, an oscilloscope, and perhaps a voltmeter. Both 9000 models, as an option, offer automatic calculation of rise/fall time and pulse width to 10nsec resolution with a single keyboard command. In the case of a rise time measurement, the microprocessor automatically scans the pulse to determine the appropriate voltage range. Then the microprocessor measures the peak of the pulse, calculates the 10% and 90% voltage levels, sets the trigger levels, and makes the measurement. All in less than one second. In addition, the 10% and 90% voltage levels are displayed on the front panel and are available to the system's interface. A similar measurement technique is used for fall time and pulse width measurements as well.

10 nanosecond Resolution.

The resolution for both period and time interval measurements is 10 nanoseconds. Two identical, independent channels can be used to determine the start and finish of the measurement. This permits the time between events occurring in different circuits to be measured in a straightforward manner.

100psec Resolution with Time Interval Averaging.

With time interval average capability in both the 9015 and 9035, measurement accuracy and resolution can be improved when measuring repetitive signals. For example, propagation delays through integrated circuits can be measured to resolutions of 100psec when the input signal is asynchronous with respect to the counter time base.

High Accuracy, Low Frequency Measurements Without Delay.

A conventional counter cannot provide high resolution and high accuracy when measuring frequencies less than 100KHz. A 10Hz signal measured on a conventional counter for one second will be displayed as 000000010Hz, a two digit reading with a ±10% error. To cut the error to 1%, a 10 second gate time is required. To reduce the error to 0.1%, a 100 second gate time is needed. The special automatic computing or reciprocal counters designed to solve this problem read 10.0000000Hz in one second with an accuracy of ±0.00001%. Unfortunately, these reciprocal counters are very limited in making measurements above 10MHz. Well, now it's possible to get

the best of both. The 9000 Series counters, with their unique microprocessing power, provide full 9-digit resolution and accuracy at any frequency from near DC to over 500MHz.

"Period" Measurements to 2nsec.

With the Model 9035, frequency measurements to 512MHz can be displayed as either frequency or time with the single key entry of "1/x." Thus, 9-digit resolution is obtained for period measurements from 2 nanoseconds to more than 10 seconds. The 9015 is able to provide 9-digit resolution from 10 nanoseconds to more than 10 seconds.

Direct Readout in Engineering Units.

Now with keyboard entry and microprocessing control, measurements can easily be scaled, biased or inverted to provide direct readout in other engineering units. For example, to convert frequency to RPM, the "×k" constant key is hit, the number 60 is entered on the keyboard and the "×k" key is hit once more. The answer is now in RPM with 9-digit resolution. Or, the Series 9000 can be set up as a deviation meter by keying the "+k" button, entering the desired center frequency, then again keying the "+k" button. The readout now displays the plus or minus deviation from the entered frequency.

Ultra-high Stability Time Base Available.

The standard temperature compensated crystal oscillator (TCXO) provides an average aging rate of $<3\times10^{-7}$ per month. Since no temperature controlled oven is used, extended warm-up times are not required when moving the counter from one location to another. Two higher stability reference oscillators are also available. The Option 22 provides an aging rate of $<1\times10^{-9}$ per day. The Option 24 provides an aging rate of $<5\times10^{-10}$ per day. Both offering ultra-stable reference, which extend the time between calibrations and can also serve as a secondary reference standard.

Microprocessing Power in the System.

Because of the computing capability of the 9000, system interface and data manipulation are simplified. Both the program software and electronic interface are easier.

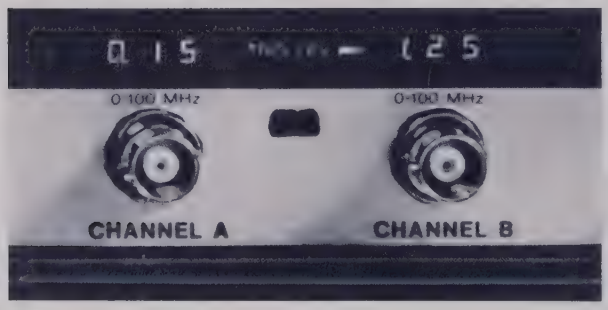
Options tailored specifically to your type of system are available, including three complete system interface options and a data output option. The three microprocessing controlled system options provide complete digital programming capability. Even trigger levels and input controls can be digitally programmed from remote locations.

Reduced CPU Time.

The Series 9000 cuts "on-line" time and CPU time by performing data calculations at the instrument. Data conversions and other manipulations that, in the past had to be done in the CPU, can now be done in the counter. And only the desired information is transmitted to the CPU.

Digital Trigger Control.

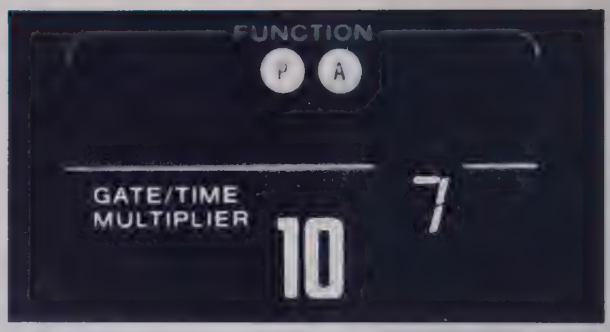
Trigger levels can be set either automatically for frequency and period measurements or with digital entry to the microprocessor controlled 9-bit DAC's. Two 3-digit LED displays on the front panel provide continuous readout of the programmed trigger levels for the system operator's convenience.



For automatically determined trigger levels, their digital values are provided at the output for system use. For example, a Series 9000 Counter equipped with the option to measure pulse width will also provide the 50% level of the pulse height, which the controller can convert to the total pulse height.

Front Panel Status.

When the 9000 is in remote control, the front panel status indicators are used as a visual readout of all the programmed input. Thus, for system checkout or troubleshooting, a step-by-step visual readout is available. This eliminates the need to interpret special codes on output devices, and guessing whether the proper programming information was received by the counter.



In addition, when the 9000 is under remote control a "Remote" indicator is lit on the front panel for operator use.

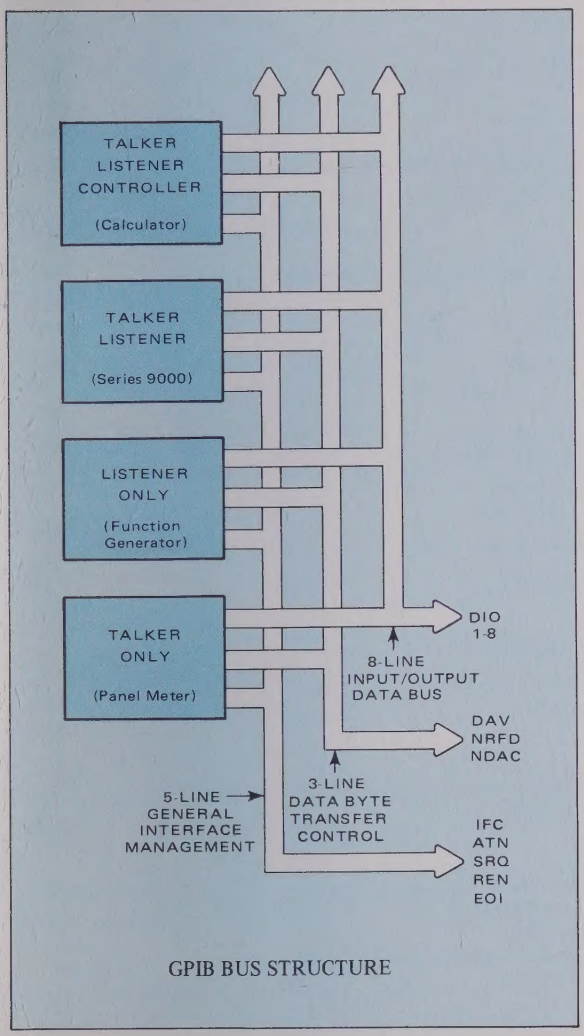
Keyboard Lockout.

For both the GPIB and High Speed Computer Options, all keyboard controls, even the "remote" key, can be overridden by the system control. This provides system protection by preventing erroneous readings which are often encountered when a front panel control has been accidently placed in a non-remote position.

General Purpose Interface Bus.

To simplify the interconnection of instrumentation built by different manufacturers, a standard interface bus was developed and approved as IEEE Std 488-1975. The Series 9000 GPIB meets all the specifications of IEEE Std 488 and can be connected with any other instrumentation equipped with the "bus." Thus, instrumentation systems for lab or production use can now be easily built up with a

minimum of effort – because the connectors, wiring, handshaking, and all other aspects of getting the information from one instrument to another have already been designed.



GPIB BUS STRUCTURE

High Speed Computer Interface.

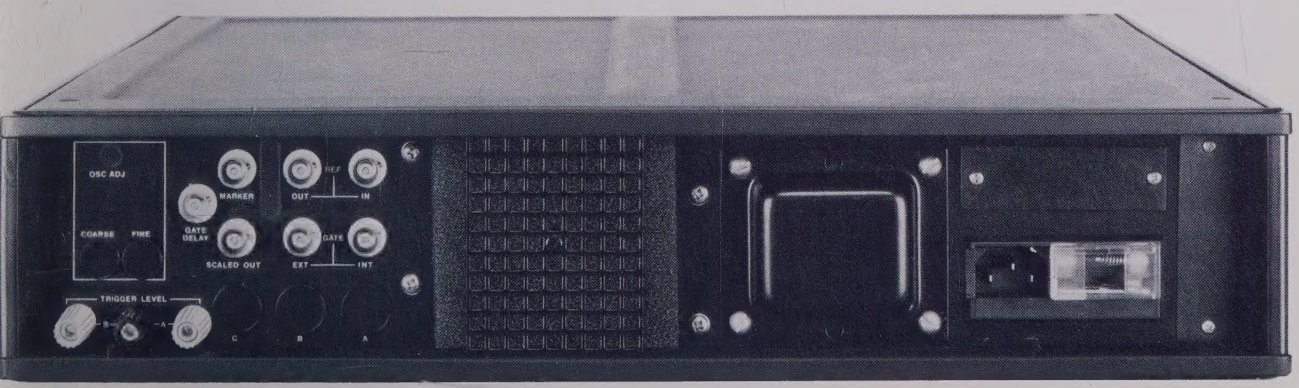
For system applications which require high speed data transfer rates or where the system components are physically separated by large distances, the High Speed Computer Interface is available. A parallel bit format for both input and output is used to maximize the data transfer rate. The basic interface structure consists of 5 control lines, 16 input lines, and 47 output lines. Because tristate drivers are used in the logic, one of three input/output interfaces or an output-only interface can be built up from the basic interface structure by the user. The 16-bit duplex interface and the 40-bit with 16-bit bi-directional interface can be operated at two different data rates, depending whether the measured data has been operated upon by the microprocessor or not. The 40-bit printer output also can operate in one of two data rates. The third input/output interface is a 16-bit bi-directional or tyable with jumpers operating under computer control. The numeric output is BCD coded with all inputs and outputs being compatible with TTL logic levels.

Serial ASCII System Interface.

With this option, the Series 9000 can be directly hooked up to a keyboard printer, such as a teletype terminal. The terminal can then be used as a printer for the Series 9000, or it can serve as a controller for up to ten instruments utilizing this interface. The terminal can also be used as an I/O device for entering data to a remote computer. To insure user flexibility, three output formats are provided: RS-232, TTL, and 20mA TTY.

Parallel BCD Output.

The Series 9000 with Option 51 can be easily interfaced to digital recording equipment. TTL compatible outputs of data, units, and decimal point are provided, using solid state techniques for increased speed and reliability. It includes a print command indicating that the data is at the output and can be printed. Also provided are hold and reset lines for read rate control by the recorder.



Dana Series 9000 Specifications

INPUT CHARACTERISTICS

Channel A & B

Frequency Range	
DC Coupled:	0 to 100MHz
AC Coupled:	20Hz to 100MHz
Coupling:	DC or AC, switch selectable
Sensitivity	
Sinewave:	25mV rms to 1MHz 50mV rms to 50MHz 100mV rms to 100MHz
Pulse:	150mV p-p; 8nsec minimum width
Input Impedance:	1Mohm shunted by less than 25pF
Maximum Input: (without damage)	250V rms or 300V peak on all ranges. On 1V range, degrades by 20dB/decade above 1MHz to 2.5V rms at 100MHz
Voltage Ranges:	1, 10, 100; keyboard selectable or automatically selected
Trigger Level:	Digitally adjustable (keyboard entry) to ±300% of voltage range; calibrated to resolution of ±1.25% of voltage range. Digital levels displayed on front panel and analog levels (DAC outputs) available on rear panel.
Input Trigger Level Accuracy:	±5% of range ±.1% range per °C.
Output Trigger Level Accuracy:	±2% of range of actual trigger point.

Channel C (Model 9035 only)

Frequency Range:	100MHz to 512MHz
Sensitivity	
Sinewave:	15mV rms
Input Impedance:	50 ohms nominal
Maximum Operating Input:	1V rms
Maximum Input Without Damage:	5V rms (fuse protected)
Automatic Gain Control:	40dB without adjustment
Prescale Factor:	10

FREQUENCY MEASUREMENT TO 100MHz

Frequency Range	
DC Coupled:	0 to 100MHz
AC Coupled:	20Hz to 100MHz
Accuracy	
Standard Mode:	±1 count ± reference error
Computing Mode:	$\pm 1 \times 10^{-8}$ of reading ± trigger error* / Measurement Time ± reference error
Input:	Channel A
Measurement Time	
Standard Mode:	1µsec to 10 seconds, selectable in decade steps
Home State	
Measurement Time:	.1sec
Frequency Resolution:	10Hz
Reciprocal Mode (1/x):	Displays period, 10nsec to 10^6sec
Display:	9 digits; mHz, Hz, KHz or MHz
Self Test: (10^{-1}sec time base)	10.00000MHz

*trigger error $\frac{\leq 0.0025\mu sec}{\text{signal slope (in V/}\mu sec)}$

FREQUENCY MEASUREMENT TO 512MHz

(Model 9035 only)

Frequency Range:	100MHz to 512MHz
Accuracy:	±1 count ± reference error
Input:	Channel C
Measurement Time:	1msec to 10sec, selectable in decade steps
Home State	
Measurement Time:	.1sec
Frequency Resolution:	100Hz
Reciprocal Mode (1/x):	Displays period, 2nsec to .1µsec
Display:	9 digits, MHz

TIME INTERVAL MEASUREMENTS

Range:	10nsec to 10^9 sec
Resolution:	10nsec
Accuracy:	±1 count ± reference error ± trigger error*
Input	
Separate Mode:	Channel A start and Channel B stop
Common Mode:	Channel A start and stop
Home State	
Resolution:	10nsec
Reciprocal Mode (1/x):	Displays $\frac{1}{\text{Time Interval}}$; 10^{-6} to 10^{-8}
Display:	nsec, µsec, msec, sec, ksec, or Msec

TIME INTERVAL AVERAGE

Range:	100psec to 1sec
Accuracy:	± reference error ±2nsec ± (trigger error* + 10nsec) / $\sqrt{\text{No. of Intervals Averaged}}$
Intervals Averaged:	10 to 10^9, selectable in decade steps
Dead Time:	Minimum time between stop and start: 50nsec
Input	
Separate Mode:	Channel A start and Channel B stop
Common Mode:	Channel A start and stop
Home State	
No. Intervals Averaged:	10
Resolution:	1nsec
Reciprocal Mode (1/x):	Displays $\frac{1}{\text{Time Interval Average}}$; 1 to 10^8
Display:	psec, nsec, µsec, msec, or sec

PULSE PARAMETER MEASUREMENTS

(Option 11)

Initiation of the required measurement by a single key entry activates the microprocessor to measure the pulse amplitude, calculate and set the required start/stop trigger level settings, and initiate the counter to take the time interval measurement. The start and stop trigger level values are displayed on the front panel and are available to the system output.

Rise Time	
Start Point:	10% of pulse amplitude, positive slope.
Stop Point:	90% of pulse amplitude, positive slope.
Fall Time	
Start Point:	90% of pulse amplitude, negative slope.
Stop Point:	10% of pulse amplitude, negative slope.
Pulse Width	
Start Point:	50% of pulse amplitude, positive slope.
Stop Point:	50% of pulse amplitude, negative slope.
Range	
Single Measurement:	10nsec to 10^9sec
Multiple Intervals Measurement:	100psec to 1sec
Intervals Averaged:	1 to 10^9, selectable in decade steps

(Continued Option 11)	
Time Measurement Accuracy	
Single Measurement:	±1 count ± reference error ± trigger error*
Multiple Intervals Measurement:	± reference error ±2nsec ± (trigger error* + 10nsec) / √No. of Intervals Averaged
Trigger Level Setting Accuracy:	±5% of voltage range
Input:	Channel A
Minimum Pulse Height:	0.5V
Display:	nsec, µsec, msec, sec, ksec, or Msec

PERIOD MEASUREMENTS

Range:	10nsec to 10^9sec
Resolution:	10nsec
Accuracy:	±1 count ± reference error ± trigger error**
Input:	Channel A
Home State	
Resolution:	10nsec
Reciprocal Mode (1/x):	Displays frequency, 1Hz to 100MHz
Display:	nsec, µsec, msec, sec, ksec, or Msec

PERIOD AVERAGE

Range:	10nsec to 1sec
Accuracy:	± reference error ±2nsec / ± trigger error** / No. of Periods Averaged
Intervals Averaged:	1 to 10^8, selectable in decade steps
Input:	Channel A
Home State	
No. Periods Averaged:	10^1
Resolution:	1nsec
Reciprocal Mode:	Displays frequency, 1Hz to 100MHz
Display:	nsec, µsec, msec, or sec

FREQUENCY RATIO MEASUREMENTS

Frequency Range	
Channel A:	0 to 100MHz
Channel B:	0 to 100MHz
Ratio:	10^{-8} to 10^8
Multiplier:	f_B scaled by 1 to 10^9 selectable in decade steps
Accuracy:	±1 count of f_A ± trigger error* of f_B
Home State	
Multiplier:	10
Reciprocal Mode (1/x):	Displays multiplier $f_B \div f_A$, 10^{-8} to 10^6
Display:	$f_A \div$ multiplier f_B, dimensionless

TOTALIZE MEASUREMENTS

Frequency Range:	0 to 100MHz
Count Range:	0 to 10^9
Accuracy:	±1 count per gate

SCALING

Frequency Range:	0 to 100MHz
Scaling Range	
≦10MHz:	1 to 10^9 selectable in decade steps
>10MHz:	10 to 10^9 selectable in decade steps
Input:	Channel A

*trigger error $\frac{\leqq 0.0025\mu sec}{\text{signal slope (in V/}\mu sec)}$

GENERAL SPECIFICATIONS

Calculating Capability:	ADD or SUBTRACT a constant from the measurement; MULTIPLY and DIVIDE the measurement by a constant. RECIPROCAL of a measurement.
Memory Capability:	The constant operates on successive measurements until either the measurement mode is changed or the constant/operation is changed, or the unit is reinitialized.
Constant Range:	±999.999999 EXP ±99
Automatic Ranging:	Channels A and B voltage ranges are automatically selected as a function of the input signals' voltage levels.
Manual Ranging:	Channels A and B voltage ranges are selected as a function of the trigger level resolution.
Automatic Trigger Level:	The counter measures the maximum and minimum peak of the input signal, calculates the arithmetic mean, and automatically sets the trigger level at the mean. Standard on both Channels A and B. For inputs ≧400Hz, ≧50 mV rms.
Internal Reference Oscillator	
Aging Rate:	$<3x10^{-7}$ per month
Temperature Stability:	$<5x10^{-6}$, 0°C to +50°C
Voltage Stability:	$<1x10^{-7}$ with 10% line voltage variation
Internal Reference Output:	10MHz square wave, buffered, TTL compatible
External Reference Input:	1, 5, or 10MHz; 1V rms into 1Kohm. Counter automatically locks to external reference; if present, front panel indicator lights.
Marker Output:	Negative-going pulse, 4 volt amplitude, rear BNC, duration equal to Channel A trigger point to Channel B trigger point.
Display	
Numeric:	Eleven 11mm (.43 inch) yellow LEDs. Leading and following zeros suppressed.
Status Indicators:	LED lamps show status of counter controls: function, measurement time, system control, external reference, input voltage range, slope, coupling, separate/common, and test. LED lamps show numeric readout dimensional units, overflow condition, and Channel C input status.
Trigger Level:	Two 3-digit 2.8mm (.11 inch) red LEDs
Sample Rate:	Periodic or hold, switch selectable. In periodic mode, rest time between readings is approximately 300msec.
Input/Output Connectors:	BNC
Operating Temperature:	0°C to +50°C
Line Voltage:	50 to 60Hz; 100, 120, 220, or 240V ±10%
Power Requirement:	100 watts maximum
Weight:	Net 8.6 kg (19 lb.); shipping 11.4 kg (25 lb.)

INTERNAL REFERENCE OSCILLATOR OPTIONS

Option 22	
Aging Rate:	$<1x10^{-9}$ per day
Temperature Stability:	$<5x10^{-9}$, 0°C to +50°C
Voltage Stability:	$<2x10^{-9}$ with 10% line voltage variation
Option 24	
Aging Rate:	$<5x10^{-10}$ per day
Temperature Stability:	$<5x10^{-9}$, 0°C to +50°C
Voltage Stability:	$<2x10^{-9}$ with 10% line voltage variation

**trigger error $\frac{\leqq 0.3}{(S/N)\ f_A}$

where S/N equals signal to noise ratio in volts and f_A equals input frequency.

System Interface Specifications

GENERAL PURPOSE INTERFACE BUS

(Option 55)

The GPIB is compliant with IEEE Std 488-1975, "IEEE Standard Digital Interface for Programmable Instrumentation." It provides interface capability with other instruments and controllers manufactured by other companies also utilizing the "interface bus" structure.

Programming Inputs:	All front panel controls including digital trigger levels except line power on/off switch. Program settings displayed on front panel.
Data Output Format:	±.XXXXXXXXXE±YY Mantissa resolution same as front panel display resolution.
Electrical Compatability:	Per IEEE Std 488-1975.
Programming Format:	7 bit ASCII Code.
Data Rate	
Fast:	1000 bytes per sec with no front panel display.
Slow:	≦100 bytes per sec with front panel display and/or data manipulation by internal microprocessor.

PARALLEL BCD OUTPUT

(Option 51)

Data Output	
Binary Coded Data:	Data digits, dimensional units, and decimal point. 1-2-4-8 code.
Single Line Signals:	Print.
Single Line Programming:	Hold, reset.
Logic Levels:	Positive true, standard TTL logic levels.

SERIAL ASCII SYSTEM INTERFACE

(Option 57)

Up to 10 instruments may be commanded on one line. One instrument talks or listens while others remain inactive. If an instrument is called up by its number designator, a question and answer routine is utilized to program the instrument. If the instrument is called up by its letter designator, programming input from either the keyboard or tape reader is directly accepted by the instrument without the question and answer routine.

Programming Inputs:	All front panel controls including digital trigger levels except line power on/off switch.
Data Output Format:	± .XXXXXXXXXE±YY Mantissa resolution same as front panel display resolution.
Electrical Compatability (3 outputs, pin selectable):	EIA Std., RS-232C. TTL levels. 20mA TTY.
Parity:	Odd, even or none.
Baud Rate:	110, 1200 or user defined (up to 1200 baud). Selectable by a 3-position switch.
Stop Bits:	1 or 2.

HIGH SPEED COMPUTER INTERFACE

(Option 56)

The basic interface structure for this option can be "built up" into one of four bus formats via internal switch selection and cable construction. For three of the formats, two operating speeds are available: (1) HI speed, which can be used for raw data transmission; and, (2) μ-processor speed, which allows data manipulation by the internal microprocessor.

Bus Descriptions:

a. 16-bit duplex I/O
Output: 16 lines (data)
Input: 16 lines (counter control)
5 Control lines, Remote line
HI speed or μ-processor speed

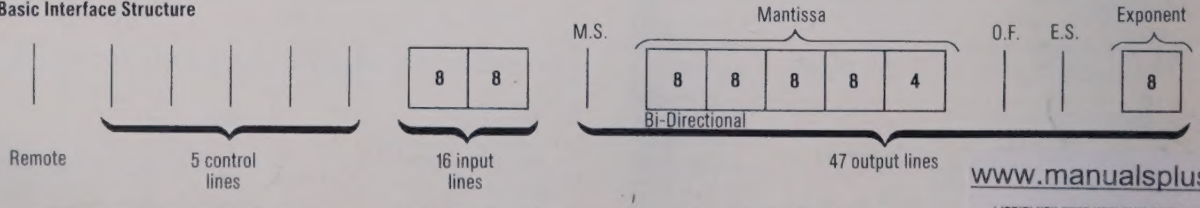
b. 40-bit printer
Output: 40 of 47 lines (data)
2 control lines, Remote line
HI speed or μ-processor speed

c. 40-bit with 16-bit bi-directional
Output: 40 of 47 lines (data)
Input: 16 lines (counter control)
5 control lines, Remote line
HI speed or μ-processor speed

d. 16-bit bi-directional
Output: 16 lines (data)
Input: 16 lines (counter control)
5 control lines, Remote line

Electrical Compatability:	Positive true, standard TTL logic levels
Data Rate:	≦5 million bits per sec

Basic Interface Structure



Remote - Places counter in remote control and disables front panel control

M.S. - Mantissa Sign Bit
O.F. - Overflow Sign Bit

E.S. - Exponent Sign Bit

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